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SINAMICS G120 Inverters

PM240-2, IP20 Power Modules / Push Through Technology (PT)

Hardware Installation Manual

Edition

12/2015

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SINAMICS G120 Power Module PM240-2

Hardware Installation Manual

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

 DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
 WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
 CAUTION
indicates that minor personal injury can result if proper precautions are not taken.
NOTICE
indicates that property damage can result if proper precautions are not taken.


If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

 WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Changes in this manual

With respect to the PM240-2 Power Modules Manual, Edition 07/2015

The manual was expanded to include FSF Power Modules.

690 V inverters: 75 kW ... 132 kW


400 V inverters: 75 kW ... 132 kW

200 V inverters: 37 kW ... 55 kW


Fundamental safety instructions

2.1 General safety instructions




 DANGER
<p>Danger to life due to live parts and other energy sources</p> <p>Death or serious injury can result when live parts are touched.</p> <ul style="list-style-type: none"> • Only work on electrical devices when you are qualified for this job. • Always observe the country-specific safety rules. <p>Generally, six steps apply when establishing safety:</p> <ol style="list-style-type: none"> 1. Prepare for shutdown and notify all those who will be affected by the procedure. 2. Disconnect the machine from the supply. <ul style="list-style-type: none"> – Switch off the machine. – Wait until the discharge time specified on the warning labels has elapsed. – Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor. – Check whether the existing auxiliary supply circuits are de-energized. – Ensure that the motors cannot move. 3. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. 4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example. 5. Secure the energy sources against switching on again. 6. Ensure that the correct machine is completely interlocked. <p>After you have completed the work, restore the operational readiness in the inverse sequence.</p>




 WARNING
<p>Danger to life through a hazardous voltage when connecting an unsuitable power supply</p> <p>Touching live components can result in death or severe injury.</p> <ul style="list-style-type: none"> • Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.




 WARNING
Danger to life when live parts are touched on damaged devices
Improper handling of devices can cause damage.
For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.
<ul style="list-style-type: none">• Ensure compliance with the limit values specified in the technical data during transport, storage and operation.• Do not use any damaged devices.





 WARNING
Danger to life through electric shock due to unconnected cable shields
Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.
<ul style="list-style-type: none">• As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.



 WARNING
Danger to life due to electric shock when not grounded
For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.
<ul style="list-style-type: none">• Ground the device in compliance with the applicable regulations.



 WARNING
Danger to life due to electric shock when opening plug connections in operation
When opening plug connections in operation, arcs can result in severe injury or death.
<ul style="list-style-type: none">• Only open plug connections when the equipment is in a no-voltage state, unless it has been explicitly stated that they can be opened in operation.

 WARNING
Danger to life due to fire spreading if housing is inadequate
Fire and smoke development can cause severe personal injury or material damage.
<ul style="list-style-type: none">• Install devices without a protective housing in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire is prevented.• Ensure that smoke can only escape via controlled and monitored paths.

 **WARNING****Danger to life through unexpected movement of machines when using mobile wireless devices or mobile phones**

Using mobile wireless devices or mobile phones with a transmit power > 1 W closer than approx. 2 m to the components may cause the devices to malfunction, influence the functional safety of machines therefore putting people at risk or causing material damage.

- Switch the wireless devices or mobile phones off in the immediate vicinity of the components.

 **WARNING****Danger to life due to the motor catching fire in the event of insulation overload**

There is higher stress on the motor insulation through a ground fault in an IT system. If the insulation fails, it is possible that death or severe injury can occur as a result of smoke and fire.

- Use a monitoring device that signals an insulation fault.
- Correct the fault as quickly as possible so the motor insulation is not overloaded.

 **WARNING****Danger to life due to fire if overheating occurs because of insufficient ventilation clearances**

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

 **WARNING****Danger of an accident occurring due to missing or illegible warning labels**

Missing or illegible warning labels can result in accidents involving death or serious injury.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, in the national language if necessary.
- Replace illegible warning labels.

NOTICE**Device damage caused by incorrect voltage/insulation tests**

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

 **WARNING**

Danger to life when safety functions are inactive

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important safety notices for Safety Integrated functions

If you want to use Safety Integrated functions, you must observe the safety notices in the Safety Integrated manuals.

2.2 Safety instructions for electromagnetic fields (EMF)



WARNING

Danger to life from electromagnetic fields

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment such as transformers, converters or motors.

People with pacemakers or implants are at a special risk in the immediate vicinity of these devices/systems.

- Ensure that the persons involved are the necessary distance away (minimum 2 m).

2.3 Handling electrostatic sensitive devices (ESD)

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.



NOTICE

Damage through electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g. conductive foam rubber or aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
 - Wearing an ESD wrist strap
 - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

2.4 Industrial security

Note

Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. For more information about industrial security, visit this address (<http://www.siemens.com/industrialsecurity>).

To stay informed about product updates as they occur, sign up for a product-specific newsletter. For more information, visit this address (<http://support.automation.siemens.com>).

WARNING

Danger as a result of unsafe operating states resulting from software manipulation

Software manipulation (e.g. by viruses, Trojan horses, malware, worms) can cause unsafe operating states to develop in your installation which can result in death, severe injuries and/or material damage.

- Keep the software up to date.
You will find relevant information and newsletters at this address (<http://support.automation.siemens.com>).
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
You will find further information at this address (<http://www.siemens.com/industrialsecurity>).
- Make sure that you include all installed products into the holistic industrial security concept.

2.5 Residual risks of power drive systems

The control and drive components of a drive system are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures.

These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used.

These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety instructions on the components and in the associated technical user documentation.

When assessing the machine's risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example,
 - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
 - Response times of the control system and of the drive
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - Parameterization, programming, cabling, and installation errors
 - Use of wireless devices/mobile phones in the immediate vicinity of the control system
 - External influences/damage
2. In the event of a fault, exceptionally high temperatures, including an open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter, e.g.:
 - Component failure
 - Software errors
 - Operation and/or environmental conditions outside the specification
 - External influences/damage

Inverters of the Open Type/IP20 degree of protection must be installed in a metal control cabinet (or protected by another equivalent measure) such that contact with fire inside and outside the inverter is not possible.

3. Hazardous shock voltages caused by, for example,
 - Component failure
 - Influence during electrostatic charging
 - Induction of voltages in moving motors
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly

Note

The components must be protected against conductive contamination (e.g. by installing them in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12).

Assuming that conductive contamination at the installation site can definitely be excluded, a lower degree of cabinet protection may be permitted.

For more information about residual risks of the components in a drive system, see the relevant sections in the technical user documentation.

Introduction

Overview

The PM240-2 Power Modules belong to the modular family of SINAMICS G120 inverters. A G120 inverter comprising Control Unit and Power Module.

Depending on the power rating in frame sizes FSA ... FSF, the following Power Module versions are supplied:

- 1 AC 200 V 0.55 kW ... 4 kW for line voltages from 1 AC 200 V ... 240 V
- 3 AC 200 V 0.55 kW ... 55 kW for line voltages from 3 AC 200 V ... 240 V
- 3 AC 400 V 0.55 kW ... 132 kW for line voltages from 3 AC 380 V ... 480 V
- 3 AC 690 V 11 kW ... 132 kW for line voltages from 3 AC 500 V ... 690 V

You can operate the Power Modules with one of the following Control Units.

- CU230P-2
- CU240B-2
- CU240E-2
- CU250S-2

For Power Modules FSA ... FSC, you require a Control Unit with firmware version V4.4 or higher.

For Power Modules FSD ... FSF, you require a Control Unit with firmware version V4.7 HF8 or higher.

Note

Commissioning the inverter

You must first commission the inverter before you can use it. Commissioning is described in the operating instructions of the relevant Control Unit. Please refer to the List Manual of the Control Unit for additional information on the inverter.



Manuals for your inverter (Page 123)

STO independent of the Control Unit

Using the PM240-2 Power Modules, frame sizes FSD, FSE and FSF, you can implement the "Safe Torque Off" safety function (STO), corresponding to PL e according to EN 13849-1 and SIL 3 according to IEC61508.



STO via Power Module terminals (Page 49).

3.1 Component specification according to UL

3.1 Component specification according to UL

The components of the SINAMICS G120 product family are UL-certified. The certification is indicated on the products using the UL Listing Mark.



You can find proof of the certification on the Internet UL certificates (<http://www.ul.com>) under "Tools / Online Certifications Directory" by entering the file number or the "Name".

The UL file number for the Power Modules of the SINAMICS G120 product family is:

- E121068 for FSA, FSB and FSC
- E192450 for FSD, FSE and FSF

3.2 Permissible motors

Use motors for inverter operation or with higher insulation levels.

Motors for 200 V Power Modules

For the 200 V Power Modules, induction motors are permissible in the range from 25 % ... 150 % of the inverter power without any restrictions.

Motors for 400 V Power Modules

For the 400 V Power Modules, induction motors are permissible in the range from 25 % ... 150 % of the inverter power without any restrictions.



Motors for 690 V Power Modules

For the 690 V Power Modules, induction motors are permissible in the range from 50 % ... 150 % of the inverter power without any restrictions.




Installing/mounting

4.1 Installation conditions

When installing the Power Modules carefully observe the conditions listed below in order to guarantee reliable, continuous and disturbance-free operation.

- The Power Module is designed for installation in a control cabinet.
- The Power Module is certified for use in environments with degree of pollution 2 without condensation; i.e. in environments where no conductive pollution/dirt occurs. Condensation is not permissible.
- The Power Modules fulfill degree of protection IP20.
- Permissible cross-sections for terminals:  Cable cross-sections and tightening torques (Page 68) .
- EMC-compliant installation:  EMC-compliant installation (Page 50).

Inverters for systems in the United States / Canada (UL/cUL)

- For configurations in conformance with UL/cUL, use the UL/cUL-approved fuses, Class J or Siemens 3NE1 semiconductor fuses, which are specified in this manual.
Fuse types and characteristic values are described in the following sections:
 -  Specific technical data, 200 V inverters (Page 71)
 -  Specific technical data, 400 V inverters (Page 79)
 -  Specific technical data, 690 V inverters (Page 89)
- Only use copper cables rated for 60°C or 75°C. For frame sizes FSE, only use cables that are certified for temperatures of 75 °C to connect the braking resistor.
- For frame size FSF, to connect line and motors only use approved ring-type cable lugs (ZMVV), which are certified for the particular voltage, with a permissible current of at least 125 % of the input and output current. Use the higher value as basis.
- The integrated semiconductor short-circuit protection does not provide cable protection. On the system side, provide cable protection in conformance with NEC or CEC, Part 1 and the local regulations.
- The inverters provide internal motor protection corresponding to UL61800-5-1. The protection threshold is 115 % of the inverter full load current. When commissioning, you can adapt the motor overload protection using parameter p0640.
- Carefully note that for plants and systems in conformance with UL/cUL, the line and output voltage may not be higher than 600 V.
- The DC link terminals, DCP and DCN, were not investigated regarding conformance with UL/cUL.

Additional requirements for CSA compliance:

Frame sizes FSA ... FSC

Install the inverter with an external suppression device with the following properties:

- Surge protection device with the appropriate certification (category checking numbers VZCA and VZCA7)
- Rated supply voltage
 - 240 V (phase with respect to ground), 240 V (phase to phase) for 200 V inverters
 - 480 V (phase with respect to ground), 480 V (phase to phase) for 400 V inverters
- Terminal voltage, $V_{PR} = 2000 \text{ V}$
- Suitable for SPD applications, type 1 or type 2

Alternatively, use a surge protection device, article number 5SD7 424-1 from Siemens AG.

Frame sizes FSD ... FSF

Overvoltage category OVC III must be ensured for all connections of the power circuit. This can mean that a surge suppressor must be connected upstream on the line side. The rated voltage of the surge suppressor must not exceed the line voltage, and must guarantee the limit values (VPR) specified here.

Line voltage		Phase to ground		Phase to phase	
		Rated voltage	VPR	Rated voltage	VPR
3 AC 200 V ... 240 V	Grounded neutral conductor	139 V	2.5 kV	240 V	4 kV
	Grounded line conductor	240 V	4 kV	240 V	4 kV
3 AC 380 V ... 480 V	Grounded neutral conductor	277 V	4 kV	480 V	4 kV
	Grounded line conductor	480 V	6 kV	480 V	4 kV
3 AC 500 V ... 600 V	Grounded neutral conductor	347 V	6 kV	600 V	4 kV
	Grounded line conductor	600 V	6 kV	600 V	4 kV

4.2 Power losses and air cooling requirements

Cooling requirements


Depending on the power loss of the individual components, the control cabinet will require a cooling airflow to prevent the components from overheating.

Formula for calculating the cooling airflow:

$$\text{Air flow [l/s]} = \frac{\text{Power loss [W]}}{\Delta T \text{ [K]}} * 0.86$$

- Power loss: Total of the power losses of the individual components.
- ΔT Permissible temperature rise in the electrical cabinet

Measures in order to ensure that the components are adequately cooled

1. Add the power losses of the individual components.
 - Power Module data:  "Technical data (Page 65)".
 - The Control Unit power loss is less than 0.04 kW.
 - Use the manufacturers data for components, for example reactors or filters
2. Calculate the air flow required, using the formula above.
3. Ensure that the control cabinet is appropriately ventilated and equipped with suitable air filters.
4. Ensure that the components have the specified clearances with respect to one another.
5. Ensure that the components are provided with adequate cooling air through the cooling openings.
6. Use the appropriate air barriers to prevent cooling air short circuits

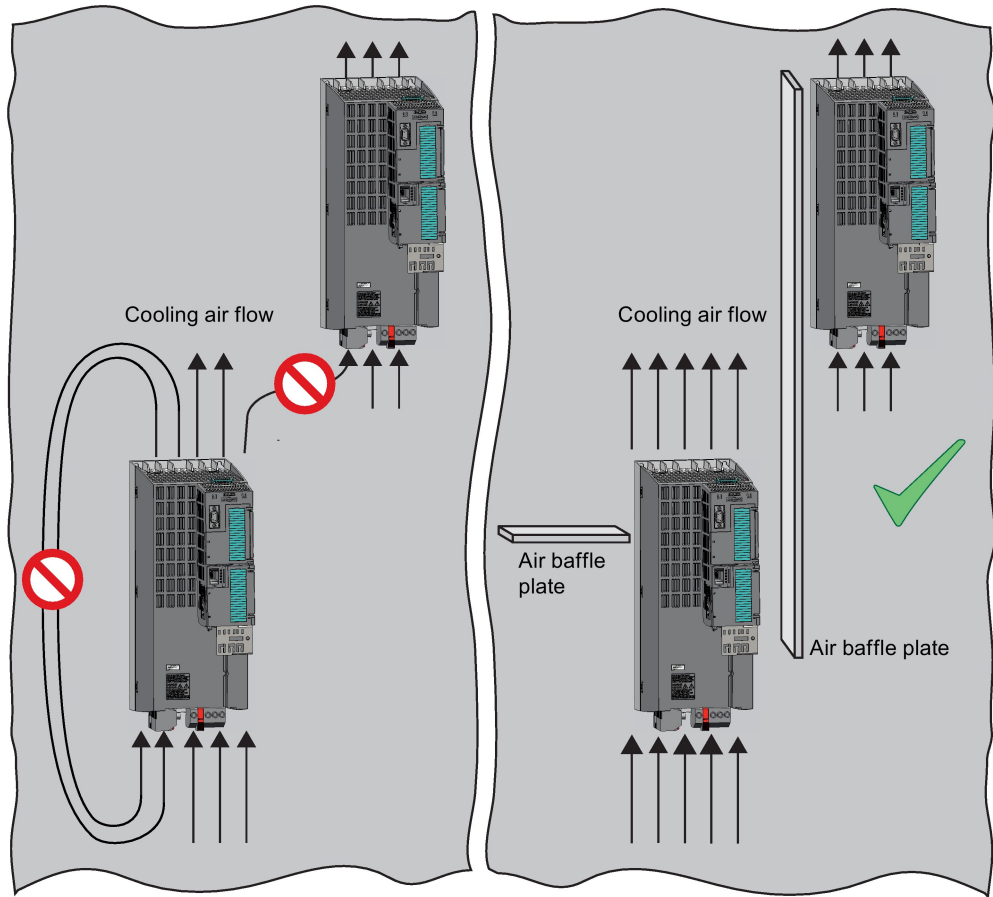


Figure 4-1 Air barriers for avoiding cooling air short circuits

Special features of Power Modules with push-through technology (PT Power Modules)

When you use PT Power Modules, the majority of the power loss is dissipated through the heatsink located outside the control cabinet.

The following losses occur in the cabinet

- FSA: 0.02 kW
- FSB: 0.045 kW
- FSC: 0.075 kW

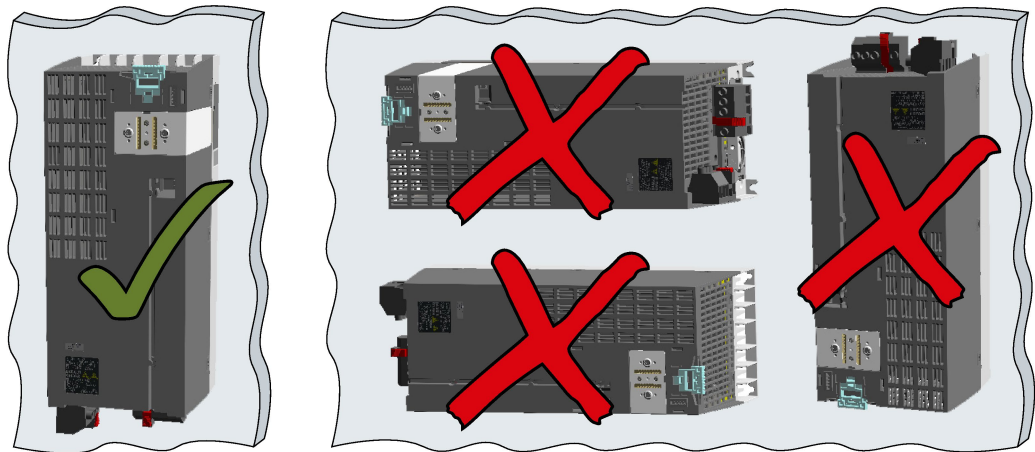
4.3 Mounting the Power Modules

4.3.1 Installing Power Modules

Installing Power Modules

The following is required to correctly install a Power Module:

- Install the Power Module in a control cabinet.
- Install the Power Module vertically with the line and motor connections facing downwards.



- Comply with the installation regulations specified in the following sections:
 - Minimum clearances to other components
 - Fixing elements
 - Tightening torques for fixing elements

Mounting Power Modules in push through technology (PT Power Module)

We recommend that you use the optional mounting frames when installing PT Power Modules in a control cabinet. This mounting frame includes the necessary seals and frame to ensure compliance with degree of protection IP54.

If you do not use the optional mounting frames, then you must ensure that the required degree of protection is complied with using other appropriate measures.

You must mount the inverter on unpainted metal surfaces in order to comply with EMC requirements.

Procedure

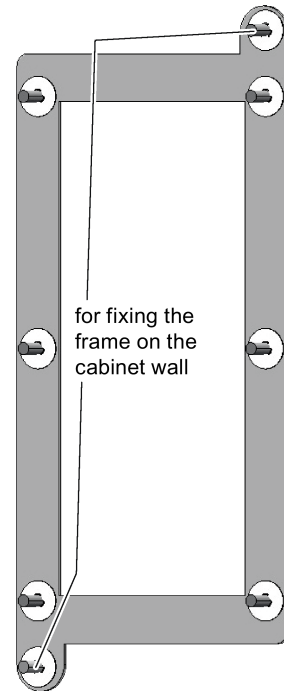


Proceed as follows to correctly install the Power Module:

1. Prepare the cutout and the mounting holes for the Power Module and the mounting frame corresponding to the dimensioned drawings of the mounting frame.

Also note that the PT Power Modules must be vertically mounted with the line and motor connections facing downwards.

2. Position the mounting frame at the rear of the control cabinet and attach it to the control cabinet by tightening the corresponding screws by hand.
3. Attach the seal to the inner side of the control cabinet.
4. Fix the inverter, and first tighten all of the fixing screws by hand.
5. Tighten the screws with a torque of 3.5 Nm.



Mounting frame

- You have correctly installed the Power Module.

Protection against the spread of fire

The inverter may be operated only in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used. The installation of the inverter in a metal control cabinet or the protection with another equivalent measure must prevent the spread of fire and emissions outside the control cabinet.

Protection against condensation or electrically conductive contamination

Protect the inverter, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12. Further measures may be necessary for particularly critical operating conditions.

If condensation or conductive pollution can be excluded at the installation site, a lower degree of control cabinet protection may be permitted.

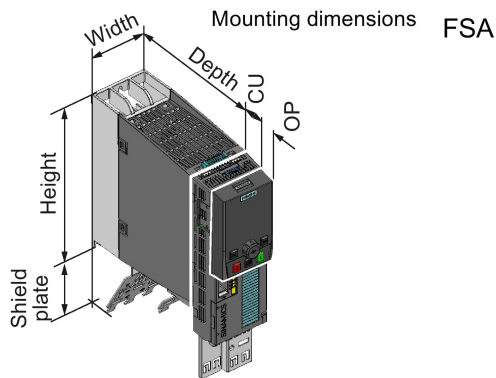
4.3.2 Dimension drawings and drilling dimensions for IP20 Power Modules

The following dimensioned drawings and drilling patterns are not to scale.

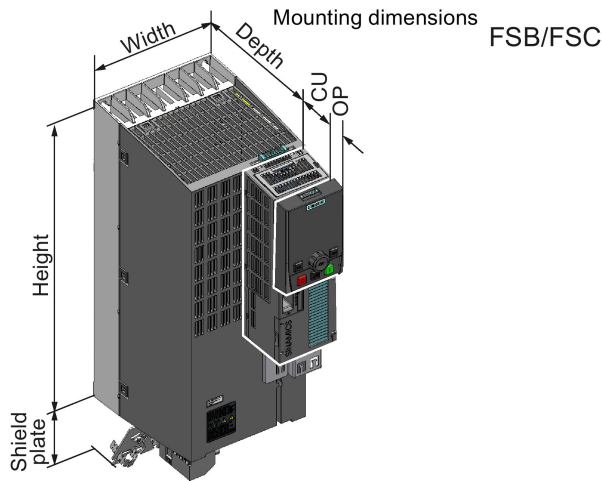
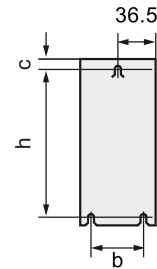
Table 4- 1 Mounting dimensions

Frame size	Width ¹⁾ (mm)	Height (mm)				Depth (mm)
		Total	Shield plate at the top	Power Module	Shield plate at the bot- tom	
FSA	73	276	---	196	80	165
FSB	100	370	---	292	78	165
FSC	140	432	---	355	77	165
FSD	200	707.5	83.5	472	152	237
FSE	275	850	122	551	177	237
FSF	305	1107	142	708	257	357

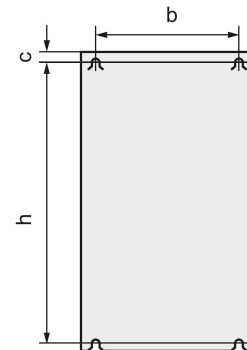
¹⁾ The Power Modules can be mounted and operated side-by-side. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.



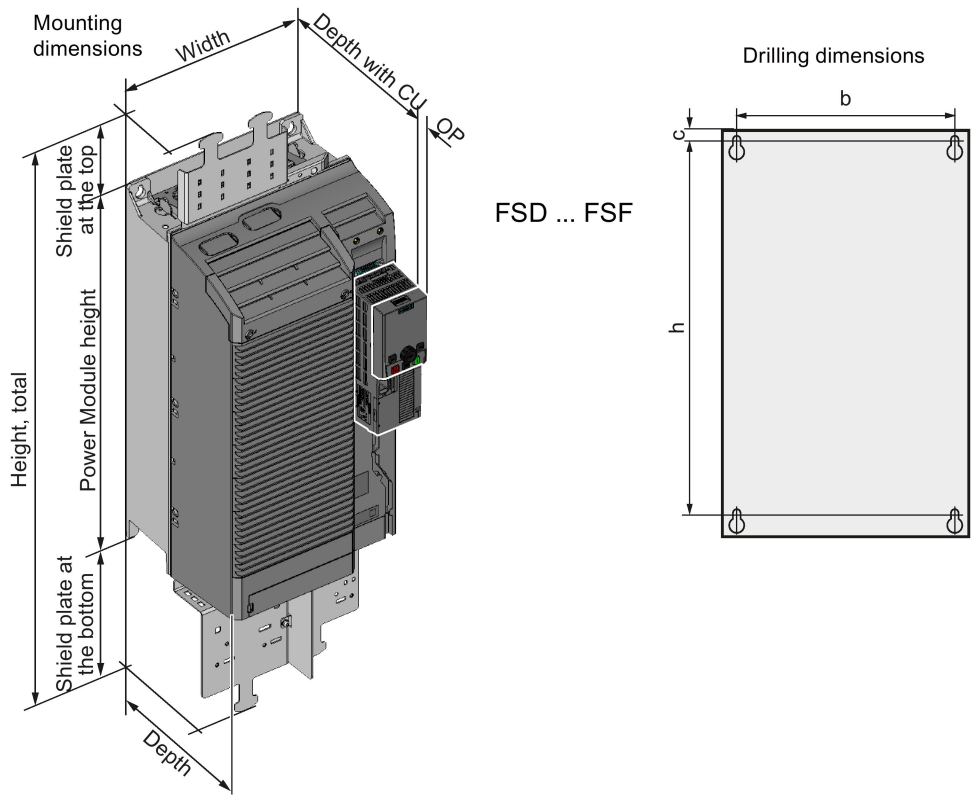
Drilling dimensions



Drilling dimensions



4.3 Mounting the Power Modules



Depth with Control Unit and Operator Panel (mm)	CU230P-2	CU240B/E-2	CU250S-2
FSA ... FSC			
• With Control Unit:	+ 59	+ 41	+ 62
• With Control Unit and blanking cover / BOP-2:	+ 70	+ 52	+ 73
• With Control Unit and IOP:	+ 81	+ 63	+ 84
FSD ... FSF			
• With Control Unit:	+ 15.5	+ 0	+ 18.5
• With Control Unit and blanking cover / BOP-2:	+ 26.5	+ 8.5	+ 29.5
• With Control Unit and IOP:	+ 37.5	+ 19.5	+ 40.5

Drilling dimensions and cooling air clearances

Table 4- 2 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions (mm)			Cooling air clearances (mm)			Fixing
	a	b	c	Top	Bottom	Front	Torque [Nm]
FSA	186	62.3	6	80	100	100	3 x M4 / 2.5
FSB	281	80	6	80	100	100	4 x M4 / 2.5
FSC	343	120	6	80	100	100	4 x M5 / 3.0
FSD	430	170	15	300	350	100	4 x M6 / 6.0
FSE	509	230	11	300	350	100	4 x M6 / 10
FSF	680	270	13	300	350	100	4 x M8 / 25

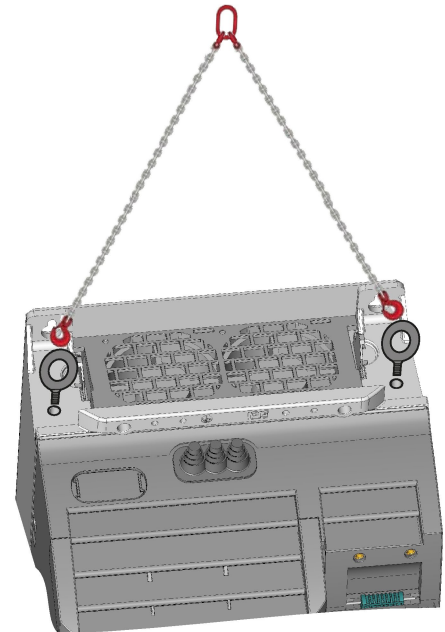
4.3.3 Hoisting gear FSD ... PSF

Hoisting gear

When mounting Power Modules FSD and FSE, use crane lifting lugs and the appropriate hoisting gear.

Weight of the Power Modules: 

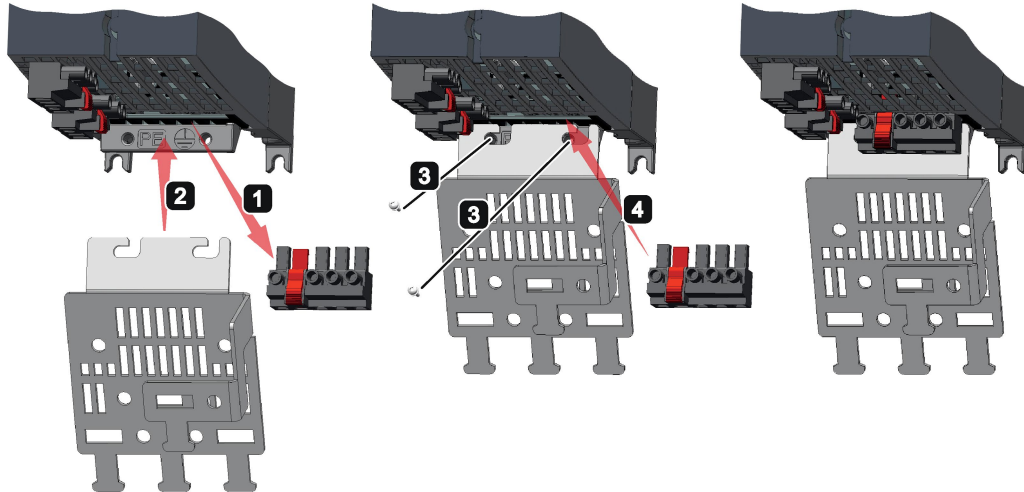
Technical data (Page 65).



4.3.4 Mounting shield plates

The shield plates and fixings screws are included in the inverter accessory kit.

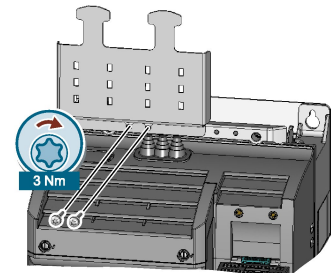
Mounting the shield plates for Power Modules, frame sizes FSA ... FSC



Mounting the shield plates for Power Modules, frame sizes FSD... FSE

Top shield plate

Mount the upper shield plate using two screws as shown in the diagram.



Lower shield module

The shield module comprises the shield plate and the EMC connecting bracket.

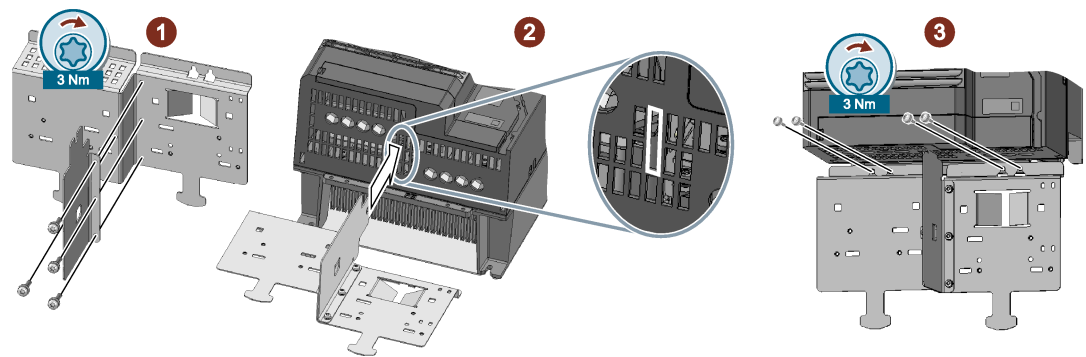
If you are using the inverter without filter, then you do not require the EMC connecting bracket. In this case, you can attach the shield plate using four screws without the EMC connecting bracket.

Note

Brake relay

If you are using a brake relay to control a motor brake, then mount the brake relay at the rear of the lower shield plate before you attach the shield module to the inverter.

 [Mounting and connecting the brake relay \(Page 117\)](#)



If you are using an inverter with integrated line filter, then you must mount the shield module as described below.

Procedure



1 Proceed as follows to mount the shield module:

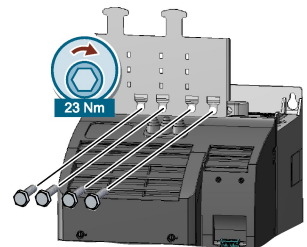
1. Attach the EMC connecting bracket to the shield plate ①.
2. Then slide the shield module into the inverter, so that it is held in the inverter ② by the clamping spring. The shield module is located correctly if it can be easily withdrawn out of the inverter without any resistance.
3. After you have ensured that it is correctly located, fix the shield module using the four screws ③.

■ You have correctly mounted the shield module.

Mounting the shield plates for Power Modules, frame sizes FSF

Top shield plate

Mount the upper shield plate using four screws as shown in the diagram.



Lower shield module

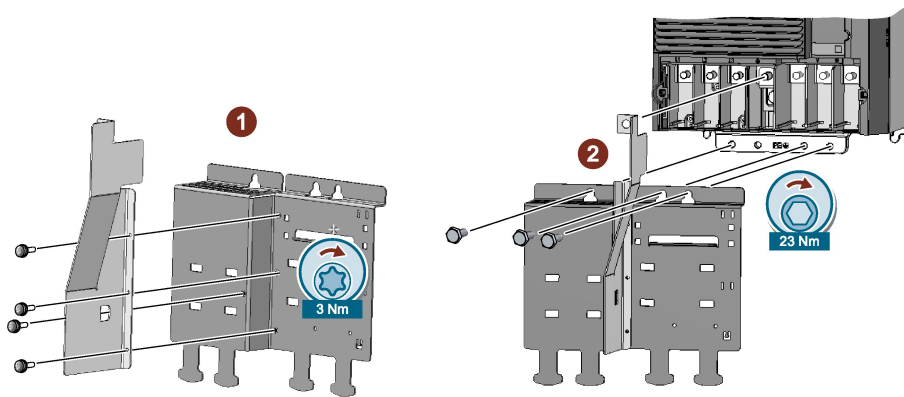
The shield module comprises the shield plate and the EMC connecting bracket.

If you are using the inverter without filter, then you do not require the EMC connecting bracket. In this case, you can attach the shield plate using three screws without the EMC connecting bracket.

Note

Brake relay

If you are using a brake relay to control a motor brake, then mount the brake relay at the rear of the lower shield plate before you attach the shield module to the inverter. See also Mounting and connecting the brake relay (Page 117)



If you are using an inverter with integrated line filter, then you must mount the shield module as described below.

Procedure



Proceed as follows to mount the shield module:

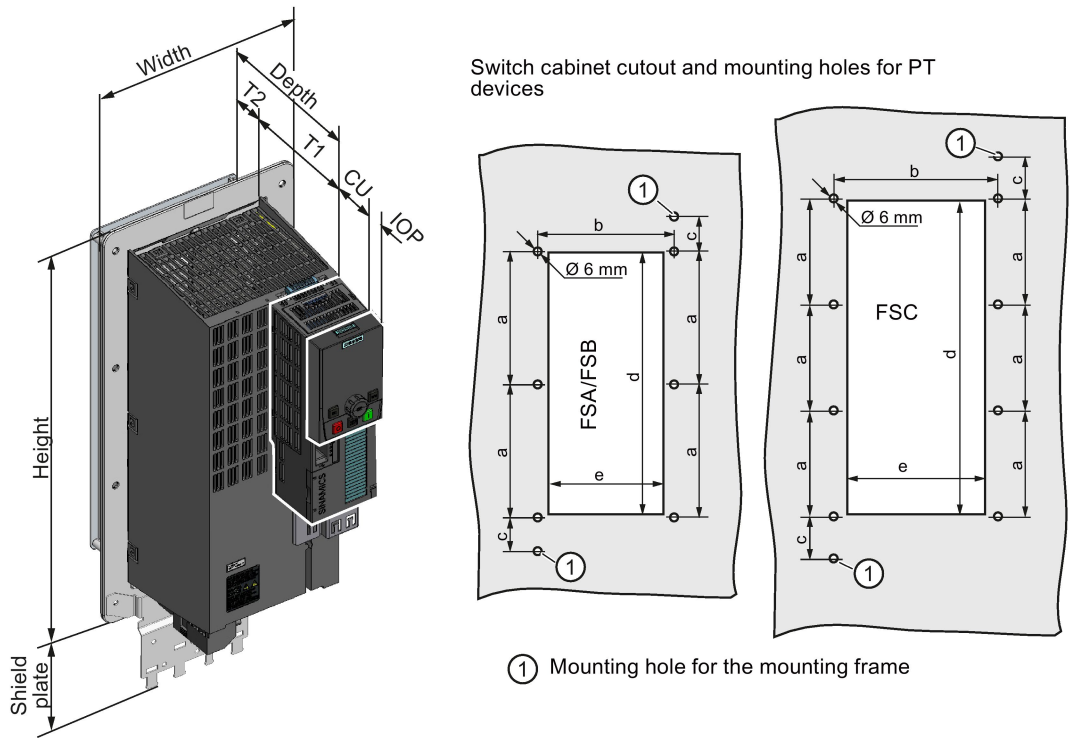
1. Attach the EMC connecting bracket to the shield plate ①.
 2. Screw the shield module to the inverter ② using three screws, as shown in the diagram.
- You have correctly mounted the shield module.

4.3.5 Dimension drawings and drilling dimensions for PT Power Modules

Table 4- 3 Mounting dimensions

Frame size	Width ¹⁾ (mm)	Height (mm)		Depth ²⁾ (mm)		
			with shield plate		T1	T2
FSA	126	238	322	171	117.7	53.1
FSB	154	345	430	171	117.7	53.1
FSC	200	411	500	171	117.7	53.1

1) The Power Modules can be mounted side-by-side. For tolerance reasons, we recommend a lateral clearance of 1 mm.
 2) Wall thickness of the control cabinet ≤ 3.5 mm



Switch cabinet cutout and mounting holes for PT devices

Table 4- 4 Depth with Control Unit and operator panel

Control Unit	Power Module + Control Unit (mm)		Power Module + Control Unit + IOP (mm)		Power Module + Control Unit + BOP (mm)	
	Total	in the cabinet	Total	in the cabinet	Total	in the cabinet
CU230P-2	231	177.7	253	199.7	244	190.7
CU240B-2 / CU240E-2	212	158.7	234	180.7	225	171.7
CU250S-2	234	180.7	256	202.7	247	193.7

Table 4- 5 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions and dimensions for the control cabinet cutout (mm)					Cooling air clearances (mm)			Fixing
	a	b	c	d	e	Top	Bottom	Front	
FSA	103	106	27	198	88	80	100		8 x M5 / 3.5
FSB	147.5	134	34.5	304	116	80	100		8 x M5 / 3.5
FSC	123	174	30.5	365	156	80	100		10 x M5 / 3.5

4.3.5.1 Mounting the shield plate

The shield plates and fixings screws are included in the inverter accessory kit.

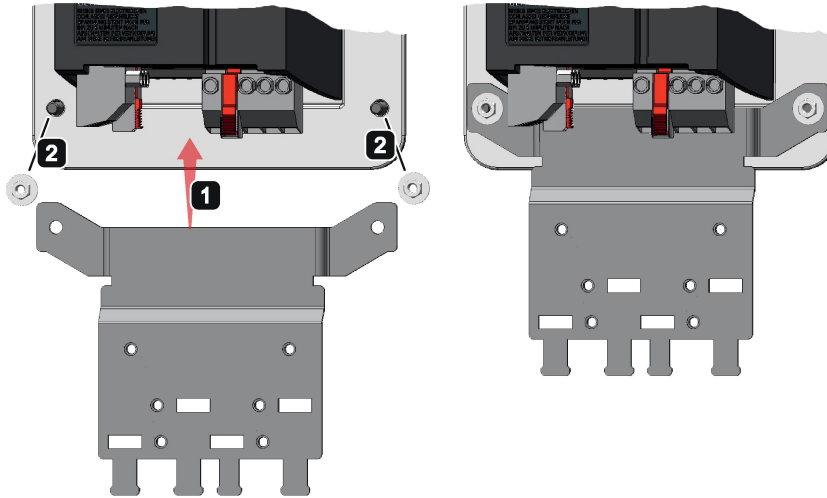
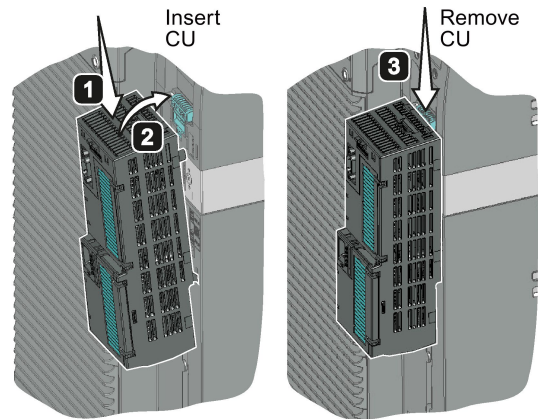


Figure 4-2 Mounting the shield plate

4.4 Control Unit installation


Plug the Control Unit onto the Power Module as shown in the diagram. By plugging on the Control Unit, you also establish all of the electrical connections between the Control Unit and the Power Module.


Press the release button on the Power Module to remove the Control Unit.



4.5 Installing supplementary components

Depending on the particular application, additional components may be required for your system. Information about additional components is provided in the following Sections:

 Connection overview (Page 42)

 Optional accessories (Page 99).

Connecting-up

Install the inverters so that you are compliant with local regulations for erecting and installing low voltage systems.

 Fundamental safety instructions (Page 11)



DANGER

Danger to life through electric shock due to the residual charge of the DC link capacitors

Because of the DC link capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off.

Contact with live parts can result in death or serious injury.

- Do not open the protective cover of the device until 5 minutes have elapsed.
- Before starting any work, check that the system is in a voltage-free state by measuring all terminals, also to ground.
- Ensure that the associated warning plate in the appropriate language is attached.

Note


Operating displays for inverter operation

If, when switching over a function from ON to OFF, an LED or other similar display is not lit or not active; this does not indicate that the device is switched-off or in a no-current condition.

Note

Safety devices

Install suitable protective equipment between the line supply and inverter.

 Technical data (Page 65)



You will find additional information on the Internet at:

To protect against indirectly touching part of the motor circuit of an inverter and to automatically shut down in the case of a fault according to DIN EN 60364-4-41 (VDE 0100-410). (<http://support.automation.siemens.com/WW/view/en/103474630>)

 **WARNING**

Danger to life due to fire or electric shock when using unsuitable residual current protection devices

The inverter can cause a current to flow in the protective conductor. This current can cause the residual current device (RCD) or residual current monitoring (RCM) to incorrectly trip (nuisance trip). In the case of a fault (ground fault), the fault current can contain a DC component, which prevents the RCD/RCM from tripping, with the risk of subsequent fault or electric shock.

- Use the protection and monitoring devices recommended in the documentation.



 **CAUTION**

Risk of injury due to hot surfaces


During operation and for a short time after the inverter shuts down, the surface of the device can reach a high temperature.

- During this time, avoid any direct contact with the surface of the inverter.

Protection and monitoring equipment

One of the following measures is suitable in order to ensure touch protection for the inverter:

- Frame sizes FSA ... FSF: Create an isolated line supply (IT line supply) by using a transformer to isolate from the line supply
- Frame sizes FSA ... FSC: Residual current device (RCD) or residual current monitoring (RCM) with the following properties and secondary conditions:
 - You are using a super-resistant RCD/RCM, type B with a tripping current of 300 mA. e.g. a SIQUENCE circuit breaker from Siemens.
 - Only one inverter is supplied from each RCD/RCM
 - The motor cables are shielded and not longer than 50 m.

 Motor cable length (Page 43)

Note

Fuses and residual current devices and/or monitoring devices

A residual current device (RCD) or residual current monitoring (RCM) does not replace the fuses listed in the Technical data.

5.1 Line and motor connection

Note:



Arrangement of the line and motor terminals (Page 45).



EMC-compliant installation (Page 50).

5.1.1 Permissible line supplies

Note

Restrictions for installation altitudes above 2000 m

Above an installation altitude of 2000 m, the permissible line supplies are restricted.



Restrictions for special ambient conditions (Page 92)

Note

Line requirement

The machine manufacturer must ensure that in operation the voltage drop between the transformer input terminals and the inverter with rated values is less than 4%.

The inverter is designed for the following power distribution systems according to IEC 60364-1 (2005).

TN line system

A TN line system transfers the PE protective conductor to the installed plant or system using a cable.

Generally, in a TN line system the neutral point is grounded. There are versions of a TN system with a grounded line conductor, e.g. with grounded L1.

A TN line system can transfer the neutral conductor N and the PE protective conductor either separately or combined.

Inverter operated on a TN line system

- Inverter with integrated or external line filter:
 - Operation on TN line systems with grounded neutral point permissible.
 - Operation on TN line systems with grounded line conductor not permissible.
- Inverter without line filter:
 - Operation on all TN line systems ≤ 600 V permissible
 - Operation on TN line systems > 600 V and grounded neutral point permissible.
 - Operation on TN line systems > 600 V and grounded line conductor not permissible.

Examples for inverters connected to a TN line system

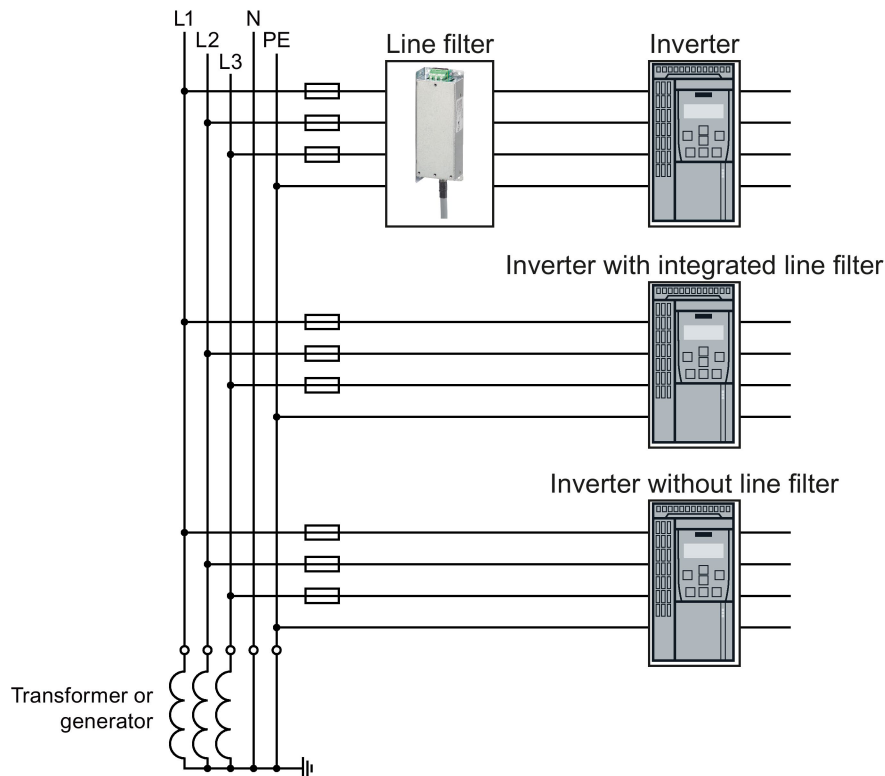


Figure 5-1 TN line supply with separate transfer of N and PE and with a grounded neutral point

TT line system

In a TT line system, the transformer grounding and the installation grounding are independent of one another.

There are TT systems with and without transfer of the neutral conductor N.

Inverter operated on a TT line system

- Inverter with integrated or external line filter:
 - Operation on TT line systems with grounded neutral point permissible.
 - Operation on TT line systems without grounded neutral point not permissible.
- Inverter without line filter:
 - Operation on all TT line systems permissible.
- For installations in compliance with IEC, operation on a TT line system is permissible. For installations in compliance with UL, operation on a TT line system is not permissible.

Examples for inverters connected to a TT line system

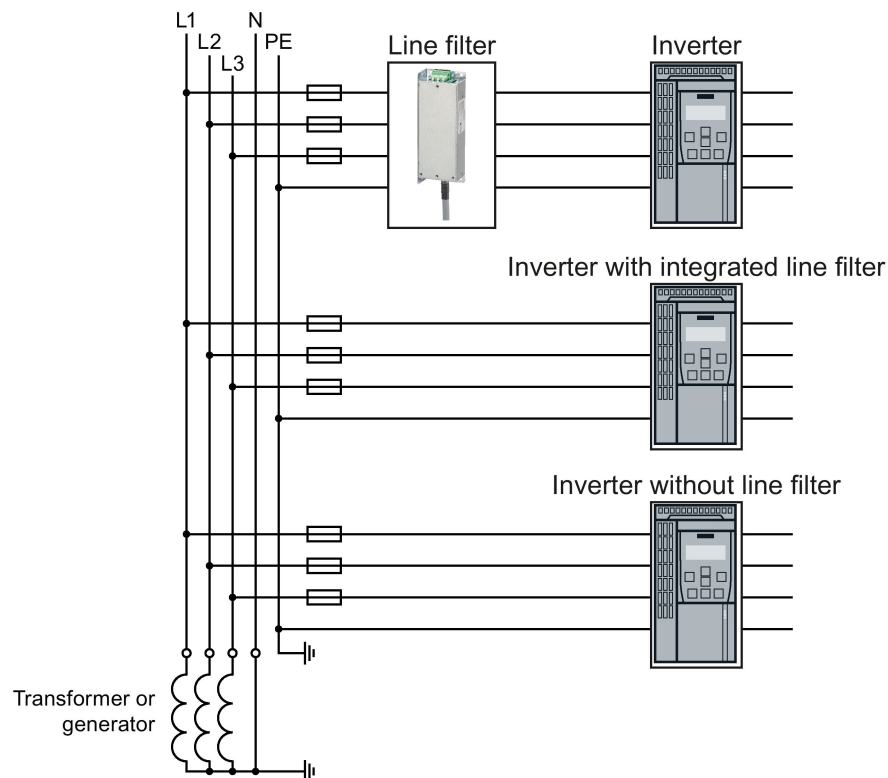


Figure 5-2 TT line system with neutral conductor N and with grounded neutral point

IT system

In an IT line system, all of the conductors are insulated with respect to the PE protective conductor – or connected to the PE protective conductor through an impedance.

There are IT systems with and without transfer of the neutral conductor N.

Inverter operated on an IT line system

- Inverters with integrated line filter:
 - Operation on IT line systems not permissible.
- Inverter without line filter:
 - Operation on all IT line systems permissible.

Example for inverters connected to an IT line system

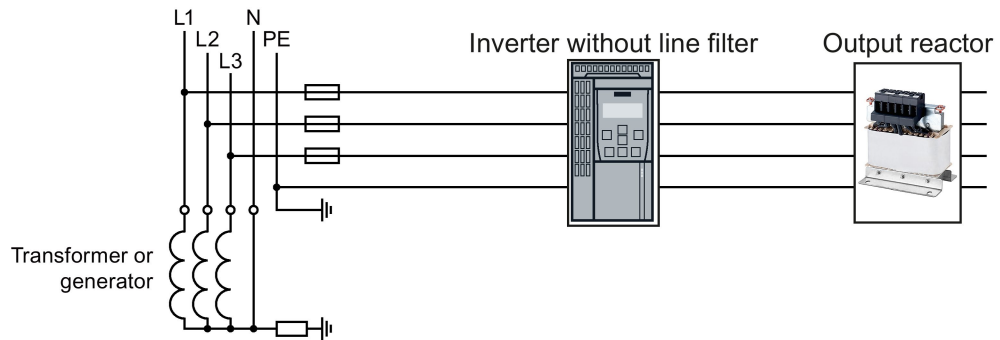


Figure 5-3 IT line supply where the neutral conductor N is transferred and with impedance with respect to the PE protective conductor

Behavior of the inverter when a ground fault occurs

In some instances, even for a ground fault, the inverter should still remain functional. In cases such as these, you must install an output reactor. This prevents an overcurrent trip or damage to the drive.

5.1.2 Dimensioning the protective conductor



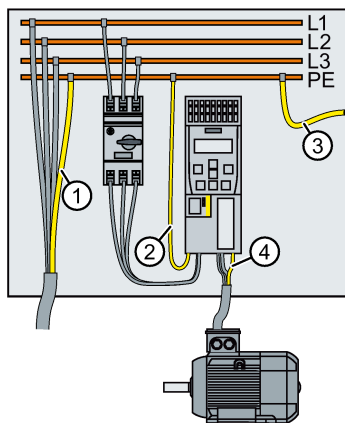
WARNING

Danger to life caused by high leakage currents for an interrupted protective conductor

The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Lay the protective conductor as specified.

Laying the protective conductor



- ① For the protective conductor of the line-system connection within a machine or system, the following applies:
 1. Observe the local regulations for protective conductors subject to an increased leakage current at the site of operation.
 2. Lay the protective conductor as follows:
 - For permanent connection, the protective conductor must fulfill at least one of the following conditions:
 - The protective conductor is laid so that it is protected against mechanical damage over its complete length.¹⁾
 - In a multi-core cable, the protective conductor core has a cross-section of $\geq 2.5 \text{ mm}^2 \text{ Cu}$.
 - In a single conductor, the protective conductor has a cross-section of $\geq 10 \text{ mm}^2 \text{ Cu}$.
 - The protective conductor consists of two conductors with the same cross-section.
 - For the connection of a multi-core cable using an industrial plug connector according to EN 60309, the protective conductor must have a cross-section of $\geq 2.5 \text{ mm}^2 \text{ Cu}$.
- ② The protective conductor must have at least the same cross-section as the line cable of the inverter.
For a cross-section of the line cable $\geq 6 \text{ mm}^2$, cross-section = 6 mm^2 suffices for the protective conductor.
- ③ The protective conductor for the connection of the PE busbar to the control cabinet housing must have at least the same cross-section as the line supply cable of the machine or system (①).
For a cross-section of the line supply cable $\geq 6 \text{ mm}^2$, cross-section = 6 mm^2 suffices for the protective conductor.
- ④ The protective conductor must have at least the same cross-section as the motor cable of the inverter.


5.1.3 Connection overview

Note

Line reactor

A line reactor is not required for the Power Modules FSD ... FSF.

Line filter

The inverters are available with or without integrated line filter (Class A). For frame sizes FSA ... FSC, 3 AC 400 V, there are external filters (Class B) for increased EMC requirements.  Line filter (Page 107)

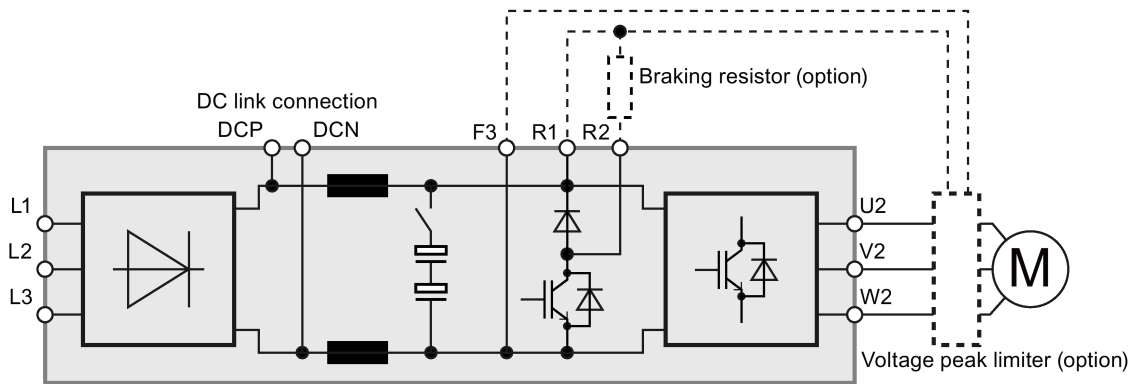


Figure 5-4 Block diagram of the inverter

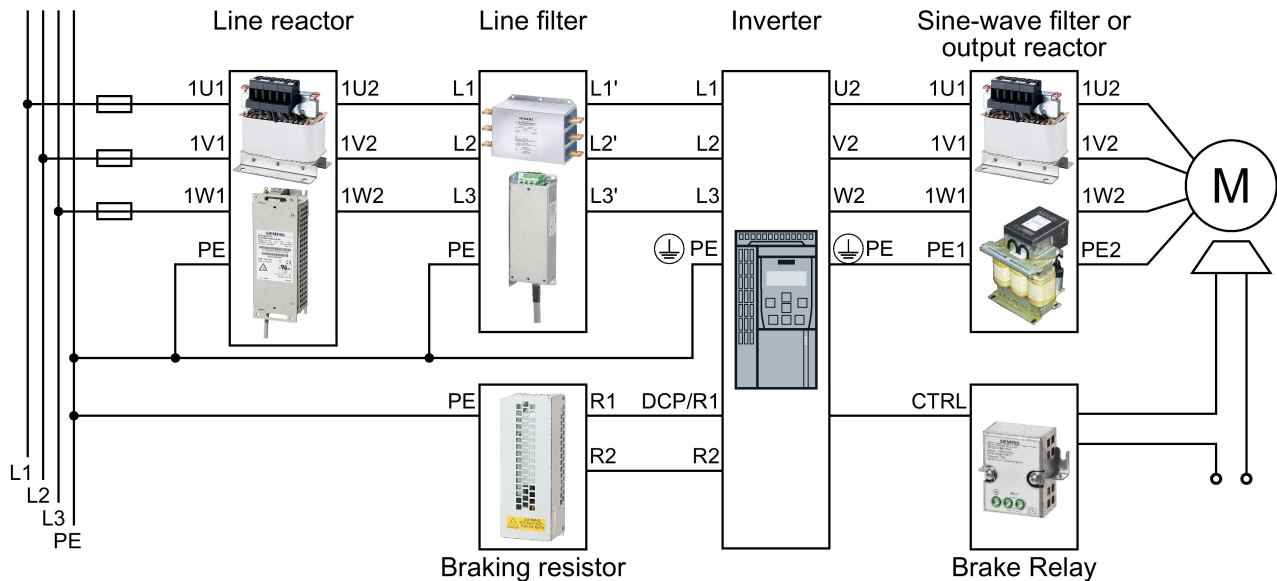


Figure 5-5 Connecting PM240-2 Power Modules, 3 AC 200 V / 400 V /690 V

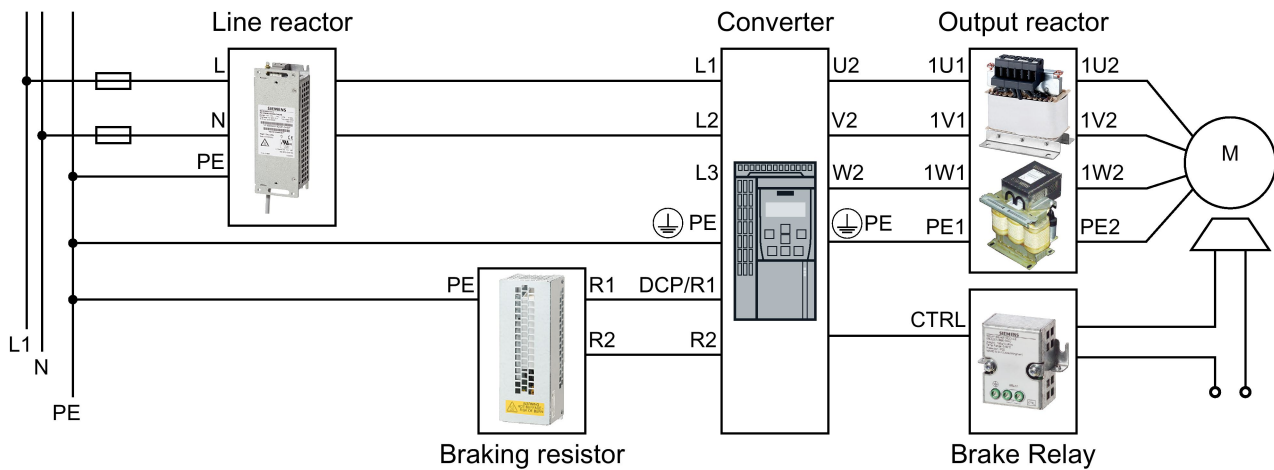


Figure 5-6 Connecting PM240-2 Power Modules, 200 V to 1 AC - only FSA ... FSC

Note


Connecting PM240-2 Power Modules, 200 V to 1 AC - only FSA ... FSC

For the 200 V versions and single-phase line systems, connect the phase conductor and neutral conductor to any two of the terminals L1, L2, L3.

5.1.4 Motor cable length

Always dimension the motor cable so that the ohmic losses are less than 5 % of the inverter power rating.

The permissible length of the motor cable also depends on the quality of the motor cable and the inverter pulse frequency. The values specified below are applicable for high quality cables, such as CY100 or similar, and for the pulse frequencies set in the factory.

 Pulse frequencies (Page 86).


If you set other pulse frequencies, then you must ensure that the EMC category is complied with on the plant or system side.

Table 5- 1 Maximum permissible motor cable length (m) for inverters with integrated filter and shielded cables

Frame size		First/second environment, EMC Category C2	Second environment, EMC category C3	No EMC category
FSA ... FSC	200 V / 400 V	50	50	50
FSD ... FSE	200 V / 400 V	150	150	200
	690V	100	100	200
FSF	200 V / 400 V	150	150	200
	690V	---	100	200

Table 5-2 Maximum permissible motor cable length (m) for inverters without filter and without EMC Category

Frame size		Shielded cable	Unshielded cable
FSA ... FSC	200 V / 400 V	50	100
FSD ... FSE	200 V / 400 V	200	300
	690V	200	300
FSF	200 V / 400 V	200	300
	690V	200	300

Inverter in the first environment:  Electromagnetic compatibility of the inverter (Page 94)

Observe the additional restrictions for inverters 6SL3210-1PE27-5UL0 and 6SL3210-1PE31-1UL0

- Motor cable length 50 m ... 100 m: set the pulse frequency to 2kHz.
- Motor cable length > 100 m: the permissible base load output current decreases by 1 % for each additional 10 m cable length.

Longer motor cables for Power Modules FSA ... FSC

For EMC Category C2, second environment, cable lengths of up to 150 m are permissible, if you use an unfiltered Power Module with an external Class B line filter and an output reactor.

5.1.5 Motor connection

Star and delta connection


Siemens motors have a diagram inside the terminal box showing both connection methods:

- Star connection (Y)
- Delta connection (Δ)

The motor rating plate provides data about the correct connection.

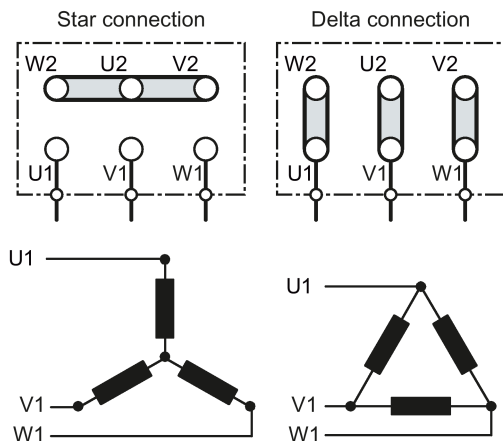
Connecting the motor

Open the terminal covers (if fitted).

Connect the protective conductor of the motor to the  terminal of the inverter.

Connect the motor cable to terminals U2, V2 and W2.










If available, close the terminal covers of the inverter.



Star connection / delta connection

5.1.6 Connection terminals at the inverter

Table 5- 3 Connection type, cable cross sections and tightening torques

Inverters	Connection		Cross-section and tightening torque		Strip lengths
			Metric	Imperial	
FSA	Line, motor cable, DC link and braking resistor		1.5 ... 2.5 mm ² 0.5 Nm	16 ... 14 AWG: 4.5 lbf in	8 mm
FSB			1.5 ... 6 mm ² 0.6 Nm	16 ... 10 AWG: 5.5 lbf in	8 mm
FSC	Line, motor cable, DC link and braking resistor		6 ... 16 mm: 1.3 Nm	10 ... 6 AWG: 12 lbf in	10 mm
FSD			10 ... 35 mm ² : 2.5 ... 4.5 Nm	20 ... 10 AWG: 22 lbf in 8 ... 2 AWG: 40 lbf in	18 mm
	Braking resistor		2.5 ... 16 mm ² : 1.2 ... 1.5 Nm	20 ... 6 AWG: 15 lbf in	10 mm
FSE	Line, motor cable and DC link		25 ... 70 mm ² : 8 ... 10 Nm	6 ... 3/0 AWG: 88.5 lbf in	25 mm
		Braking resistor		10 ... 35 mm ² : 2.5 ... 4.5 Nm	20 ... 10 AWG: 22 lbf in 8 ... 2 AWG: 40 lbf in
F5F	Line, motor cable and DC link with cable lugs according to SN71322		35 ... 2*120 mm ² : 22 ... 25 Nm	1 ... 2*4/0 AWG: 210 lbf.in	--
		Braking resistor		25 ... 70 mm ² : 8 ... 10 Nm	6 ... 3/0 AWG: 88.5 lbf in

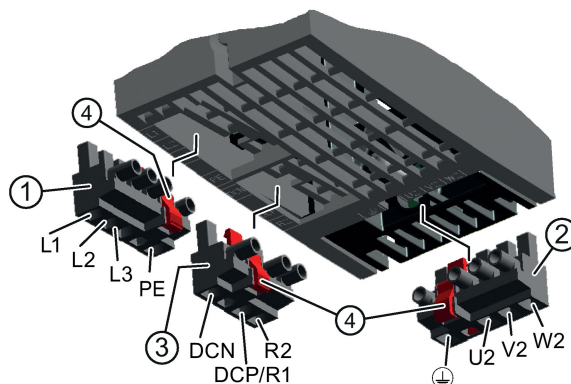
Connecting terminals FSA, FSB, FSC

The Power Modules are equipped with withdrawable connectors.

You can withdraw the connector by pressing the red lever to release the interlock.

The connectors are designed so that they cannot be accidentally interchanged.

- ① Line connectors
- ② Motor connection plug
- ③ Connection plug for a braking resistor
- ④ Release lever

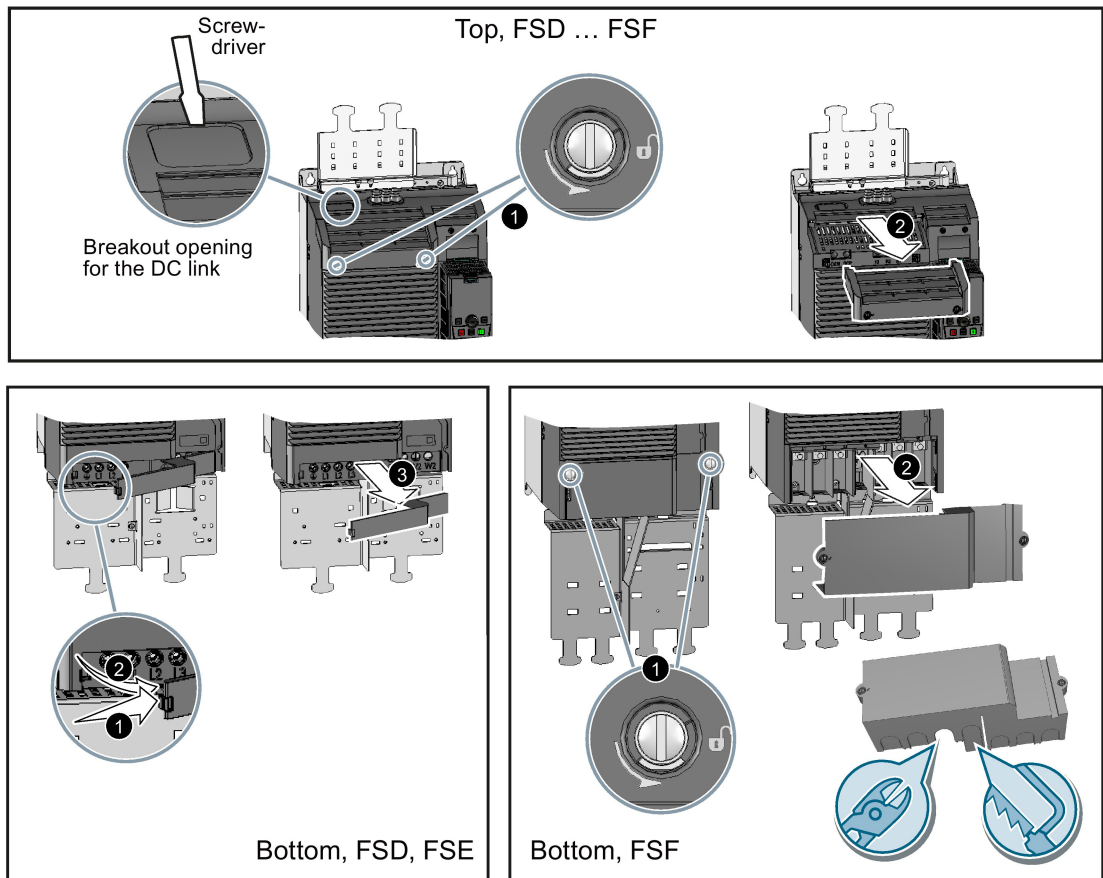


Connecting terminals for FSD ... FSF

Covers protect the connections for the line supply, motor, DC link and braking resistor and prevent coming into contact with live components. The following diagram shows how you can remove the covers. The covers are attached in the inverse order.

The connections for the motor (FSD and FSE) and braking resistor (FSD ... FSF) are also protected against contact by a blanking plug. Release the two clamping screws and remove the blanking connector before you connect the motor cable and/or the braking resistor.

Removing covers



Frame size FSF: Use a suitable tool to knock out the openings for the power connection. We recommend side cutters or a saw with a fine saw blade.

Terminal arrangement

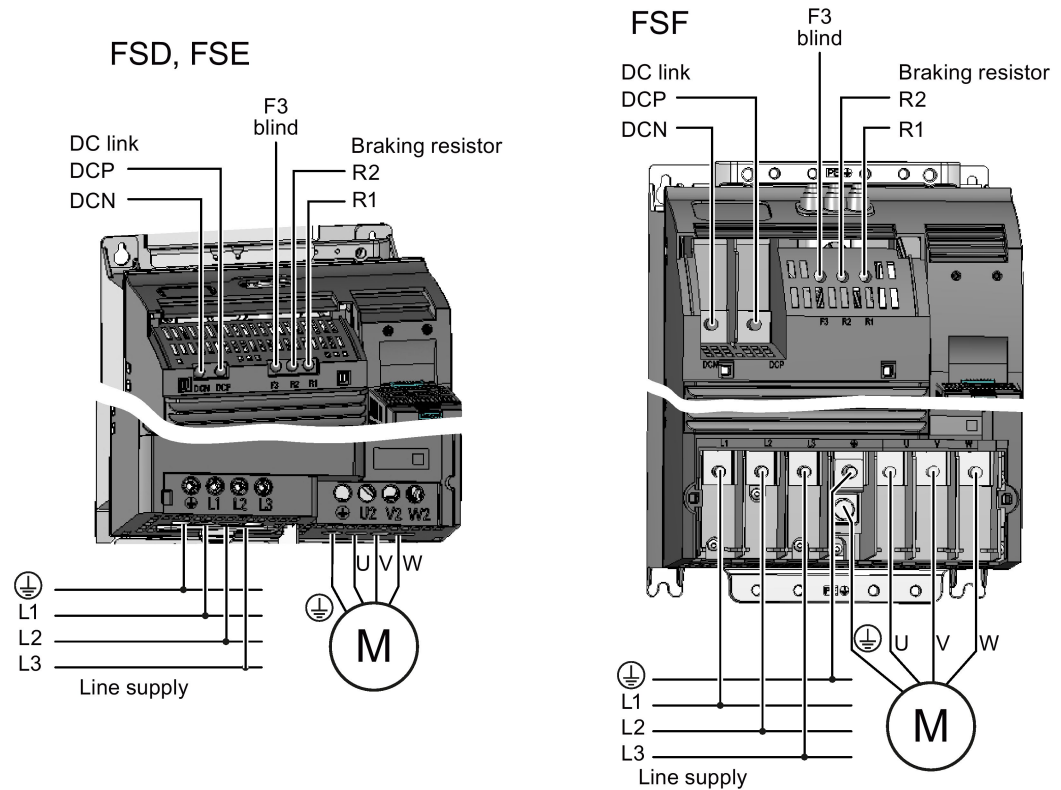


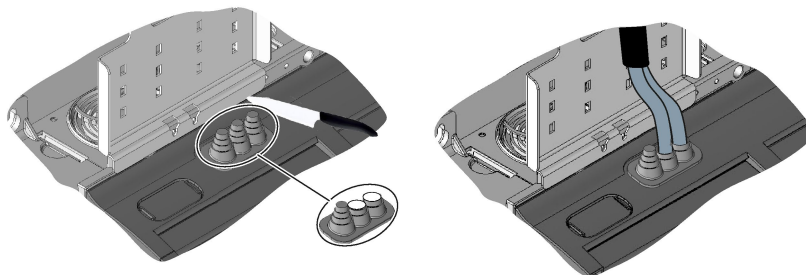
Figure 5-7 Line and motor connection PM240-2, FSF

Connecting DC link or braking resistor

You can use rubber cable glands when connecting the DC link and braking resistor.

A cable gland is already integrated to connect the braking resistor. For the DC link connection, open the knockout opening and insert the cable gland.

Using a sharp knife, cut the cap of the cable gland corresponding to the diameter of your cable and establish the connections.



Establishing connections

Procedure



Proceed as follows to establish the connections:

1. Ensure that the device is in a no-voltage condition and the DC link is discharged.
2. When available, remove the covers.
3. Establish the connections.
4. Reattach the covers before you connect the power.



You have established the connections.

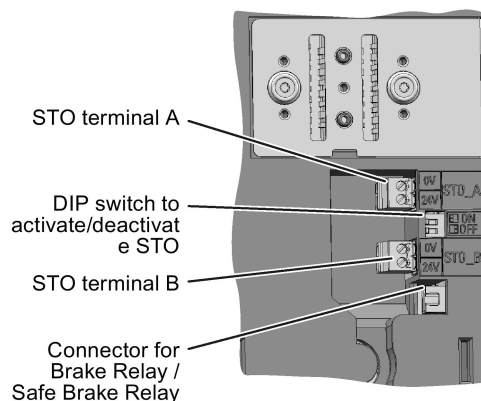
5.2 STO via Power Module terminals

Safe Torque Off (STO) for the PM240-2

Using the PM240-2 Power Modules, frame sizes FSD, FSE and FSF, you can implement the "Safe Torque Off" safety function (STO), corresponding to PL e according to EN 13849-1 and SIL 3 according to IEC61508.

You have two terminal blocks - STO(A) and STO(B) - and two DIP switches at the front of the Power Module.

To be able to use the safety functions, you must enable the terminals; you do this by setting the two DIP switches to "1". You can only use the safety function if both DIP switches are set to "1".



Set both DIP switches to "0" if you do not wish to use STO. If one switch is set to 0 and the other to 1, the inverter signals that the pulses are inhibited, and the motor does not start.

The terminals are low active.

Further information and wiring examples:  Manuals for your inverter (Page 123)

STO connection

Use shielded cables with a maximum length of 30 m, a cross-section of 0.5 mm² ... 1.5 mm² (20 ... 16 AWG), insulated for 600 V. Connect the shield to the shield plate of the Control Unit through the largest possible surface area.

Use conductor end sleeves, stripped length 7 mm.

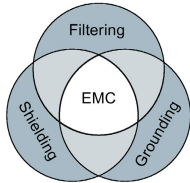
Note

Safety functions via the Control Unit

You can implement the safety functions via the Control Unit independent of the safety function "STO via the Power Module terminals".

5.3 EMC-compliant installation

5.3.1 Avoiding electromagnetic interference



Only the concurrent use of filtering, grounding and shielding ensure an installation in accordance with the EMC requirements.

The next sections cover all of the most important rules for the installation of inverter and drive systems.

5.3.2 Avoiding electromagnetic influence (EMI)

The inverters are designed for operation in industrial environments where high values of EMI are expected. Safe, reliable and disturbance-free operation is only guaranteed if the devices are installed by appropriately trained and qualified personnel.

Control cabinet design

- Establish all of the connections so that they are durable.
- Connect the metallic parts and components of the control cabinet to the frame of the cabinet through a good electrical connection.
 - Side panels
 - Rear panels
 - Cover plate
 - Base plates

Use the largest possible contact area or many individual screw connections.

- Connect the PE bar and the EMC shield bar to the control cabinet frame through a good electrical connection established through a large surface area.
- Connect all metal enclosures of the components installed in the cabinet with the control cabinet frame through a large surface area to ensure a good electrical connection. To achieve this, mount the components on a bare metal surface and mounting plate with good conductivity, which you then connect to the control cabinet frame through the largest possible surface area to establish a good connection, especially with the PE and EMC shield bars.
- For screw connections onto painted or anodized surfaces, establish a good conductive contact using one of the following methods:
 - Use special (serrated) contact washers that cut through the painted or anodized surface.
 - Remove the insulating coating at the contact locations.

- Equip the following components with interference suppression elements:
 - Coils of contactors
 - Relays
 - Solenoid valves
 - Motor holding brakes

Interference suppression elements include RC elements or varistors for AC-operated coils and freewheeling diodes for DC-operated coils.

Connect the interference suppression element directly at the coil.

Radio interference suppression

- Connect interference suppressors to all contactors, relays, solenoid valves and motor holding brakes directly at the coil in order to dampen high-frequency radiation when these devices are switched off. Use RC elements or varistors for AC-operated coils and freewheeling diodes or varistors for DC-operated coils.

Cable routing and shielding

Cables in the control cabinet

- Route the power cables of the drive so that there is a minimum clearance of 25 cm to signal and data cables. Power cables are line, DC link and motor cables – as well as connecting cables between the Braking Module and braking resistor. Alternatively, implement the separation using metal partitions connected to the mounting plate through a good electrical connection.
- Route power cables with low noise levels separately from power cables with high noise levels
 - Power cables with low noise level:
 - line cables from the line to the line filter
 - Power cables with high noise level:
 - cables between the line filter and inverter
 - DC link cables
 - cables between the Braking Module and braking resistor
 - motor cables
- Route the cables so that signal and data cables as well as power cables with low noise level only cross power cables with a high noise level at right angles.
- Keep all cables as short as possible.
- Route the cables as close as possible to grounded enclosure parts such as mounting plates or the cabinet frame.
- Route signal and data cables as well as the associated equipotential bonding cables parallel and as close to one another as possible.
- Connect the cable shields as closely as possible to the point where the cable enters the control cabinet.

- Connect the shields to the grounded enclosure at both ends with a good electrical connection through the largest possible surface area.
- Route incoming and outgoing cables/conductors within a zone (where unshielded single-conductor cables are used), twisted or in parallel and as close to one another as possible.
- Ground any unused conductors of signal and data cables at both ends.
- Signal and data cables should enter the cabinet only at one point (e.g. from below).

Cables outside the control cabinet

- Route the power cables of the drive so that there is a minimum clearance of 25 cm to signal and data cables.
- Use shielded motor cables.
- Use shielded signal and data cables.
- Route the shielded motor cable separately from the cables to the motor temperature sensors.

Cable shields

- For shielded cables, only use cables with finely-stranded, braided shields.
- Connect the shield at the grounded enclosure as well as at the EMC shield bar.
 - Connect the shields to the grounded enclosures through a large surface area at both ends of the cables to establish a low ohmic connection. Attach the shields to the appropriate EMC shield bars.
 - Immediately after the cable enters the cabinet, connect the cable shields to the EMC shield bar through a larger surface area to establish a low ohmic conduction.
- If possible, always route the cable shields without any interruptions.
- Only use metallic or metallized connectors for the plug connections for shielded data cables (e.g. PROFIBUS connection).

Further information



You can find additional information about the EMC installation guidelines under (<http://support.automation.siemens.com/WW/view/en/60612658>):

5.3.3 Installing the converter in compliance with EMC rules

Rules for cable installation to ensure EMC

- Install the inverter on a metal mounting plate. The mounting plate must be unpainted and highly electrically conductive.
- Use shielded cables for the following connections:
 - Motor and motor temperature sensor
 - Braking resistor (not available for all inverters)
 - Fieldbus
 - Inputs and outputs of the terminal strip
- Connect the cable shields to ensure EMC:

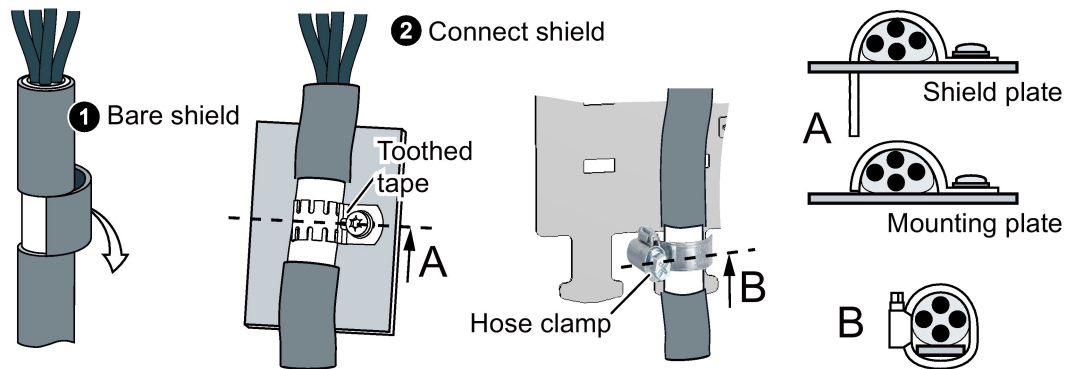
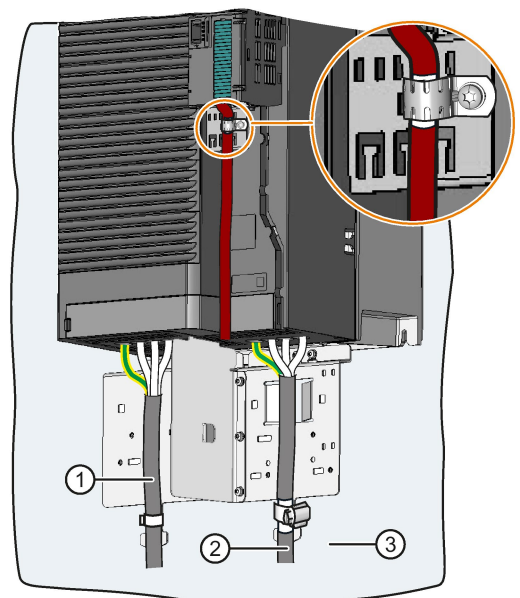


Figure 5-8 Examples of correct EMC-compliant shield connection

Example

EMC-compliant wiring for connecting the line supply and motor - as well as for the Control Unit.

- ① Line feeder cable - non-shielded - with strain relief using cable ties
- ② shielded motor cable with hose clamp for shielding and strain relief
- ③ Shielded cable for the Control Unit with shielding using a serrated strip on the CU shield plate.



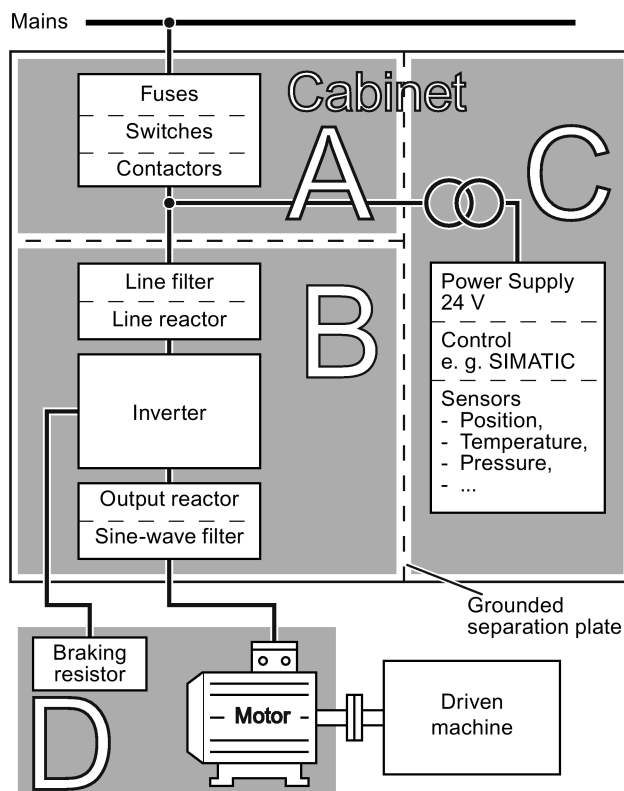
5.3.4 EMC-compliant cabinet design

The most cost-effective method of implementing interference suppression measures within the control cabinet is to ensure that interference sources and interference sinks are spatially separated.

EMC zone concept within the control cabinet

Split up the complete control cabinet into EMC zones.

Electromagnetically decouple the zones from one another, either using large clearances (approximately 25 cm) – or using a separate metal enclosure or sheet metal partition with a large surface area. Assign the various devices to zones in the control cabinet.



- **Zone A:**
Line supply connection
Limit values for conducted interference emission and interference immunity must not be exceeded.
- **Zone B:**
Power electronics
Sources of interference
- **Zone C:**
Controller and sensors
Interference sinks
- Zone D:**
Motor, braking resistor and corresponding cables
Sources of interference

Classification of the control cabinet or the drive system into EMC zones

Non-shielded cables can be used within a zone. It is not permissible to route cables of various zones in common cable harnesses or common cable ducts.

If necessary, you must use filters and/or coupling modules at the interfaces of the zones.

Use shielded cables for all communication and signal cables that exit the control cabinet. Connect the shields to the cabinet ground through a large surface area and low ohmic connection. Ensure that there are no potential differences between these zones, to avoid inadmissibly high equalization currents flowing through the cable shields.

5.3.5 Equipotential bonding

Grounding measures

Proceed as follows to ground the drive system:

- For several cabinets, install a common PE bar for all cabinet elements
- Connect all of the drive system components to the PE conductor
- Connect the PE conductor to the PE bar of the control cabinet.

Measures for high frequency equipotential bonding

Proceed as follows, to ensure high-frequency equipotential bonding:

- Connect the metallic components in the control cabinet to the PE bar and the EMC bar through a larger surface area so that a good electrical connection is established.
 - Either through a large surface area between the metal contact surfaces of the cabinet components with a minimum cross-section of several cm² for each contact location.
 - Or, alternatively using short, finely stranded, braided copper wires with cross-sections $\geq 95 \text{ mm}^2 / 000 (3/0) (-2) \text{ AWG}$.
- In plants and systems with several cabinet elements, screw the frames of the individual cabinet elements at several locations to one another using serrated washers to establish a good electrical connection.
- In plants and systems with very long rows of cabinets, which are installed in two groups back to back, connect the PE bars of the two cabinet groups at as many locations as possible.
- Therefore, connect the protective ground conductor and the cable shield to the motor and the inverter.

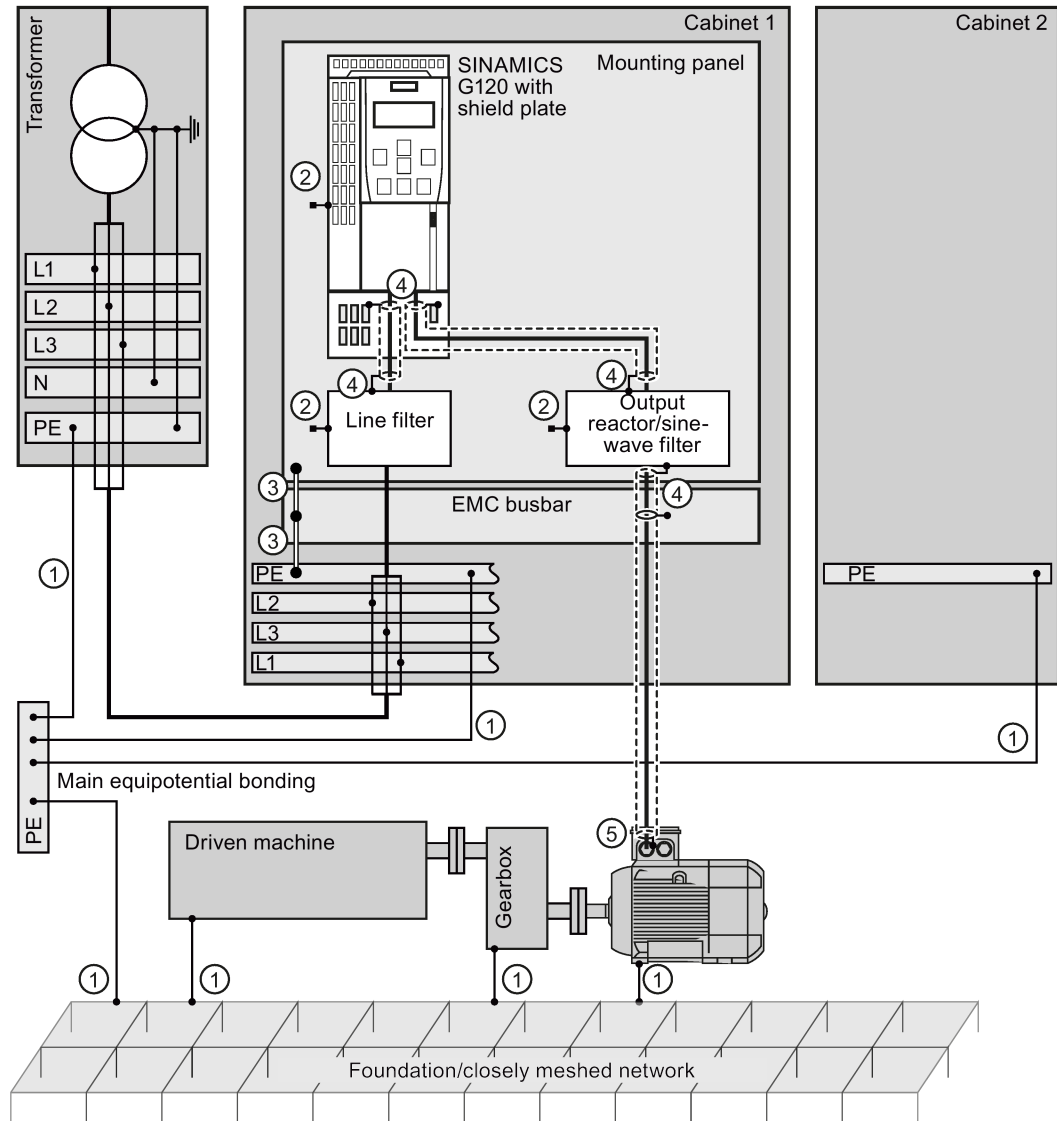
Additional measures for high frequency equipotential bonding

Route finely stranded or braided copper conductors in parallel to the motor cable with the shortest possible distance between them:

- in older systems with already existing unshielded cables
- for cables with poor high-frequency properties of the shield
- for poor grounding systems

Diagrams for grounding and high-frequency equipotential bonding measures

The following diagram illustrates all grounding and high-frequency equipotential bonding measures using the example of a cabinet with a SINAMICS G120.



Grounding measures

- ① Conventional grounding without any special HF properties

High-frequency equipotential bonding measures

- ② Electrically conductive connection to the mounting panel through the largest possible surface
- ③ HF equipotential bonding
- ④ Connect the shield through a large contact surface and ground
- ⑤ Connect the shield through an electrically conductive heavy-gauge threaded joint (gland) and ground

Figure 5-9 Grounding and high-frequency equipotential bonding measures in the drive system and in the plant

The following diagram shows the additional measures for high-frequency equipotential bonding

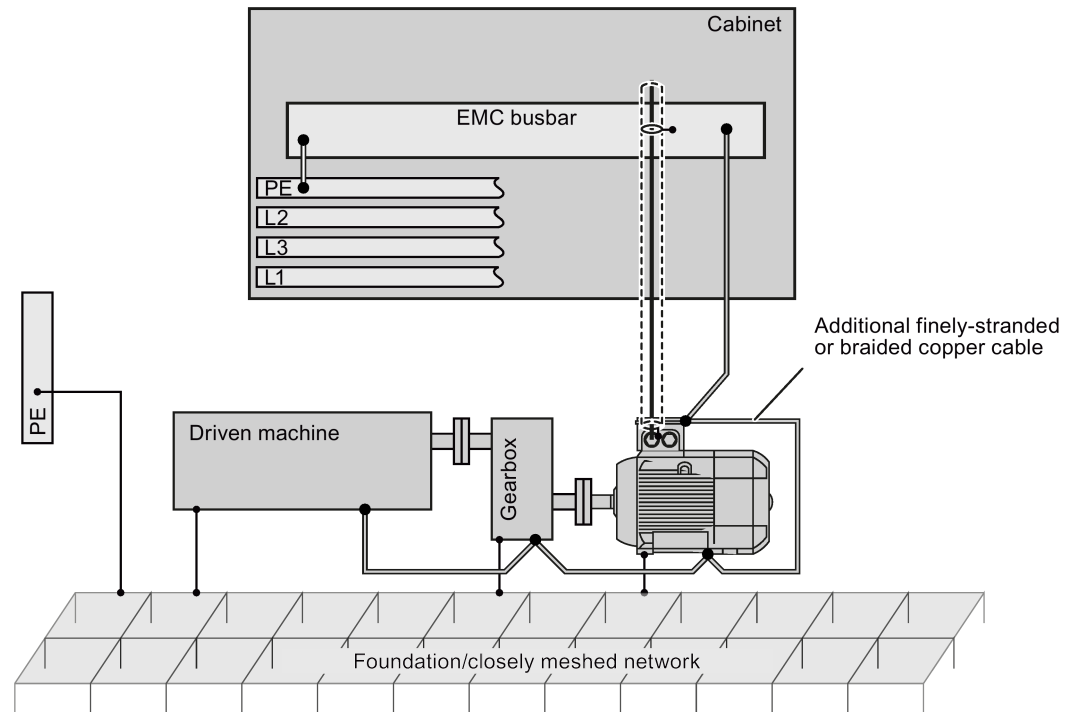



Figure 5-10 Additional measures for high frequency equipotential bonding of the drive system


Further information




You can find additional information about the EMC installation guidelines at <https://support.industry.siemens.com/cs/ww/de/view/60612658/en>:

 WARNING
Risk of fire or electric shock as a result of defective components If a cable protection element responds, this can indicate that a fault current was interrupted. Check the circuit components and all of the components of the inverter and replace defective parts and components to reduce the risk of a fire or an electric shock.

Repair

 WARNING
Danger due to incorrect repair Repairs may only be carried out by Siemens Service, by repair centers authorized by Siemens or by authorized personnel who are thoroughly acquainted with all the warnings and operating procedures contained in this manual. <ul style="list-style-type: none">• Only use original spare parts when carrying out repairs.

6.1 Maintenance

The purpose of maintenance is to maintain the specified condition of the Power Module. Regularly remove dirt and pollution, and replace the fan in plenty of time.  Replacing a fan (Page 62)

Cleaning

Inverters with IP20 degree of protection

Clean the inverter with an anti-static brush, a vacuum cleaner and areas that are difficult to access, using dry compressed air (max. 1 bar).

Inverter with through-hole technology (degree of protection IP54, UL type 12 at the rear panel of the control cabinet)

Clean the heatsink at regular intervals. If necessary, remove the air deflection plate at the rear. Use a torque of 2 Nm when reconnecting. The fans must be installed if you clean the heatsink using water.

Ventilation

The devices must be installed in a cabinet. Ensure that the cabinet's ventilation slots are not blocked. Check that the fan is functioning correctly.

Cables and screw terminals

Regularly check the cables for damage, and immediately replace any defective parts.

Regularly check that the screw terminals have been correctly tightened. Retighten the screws if necessary.

Note

The actual maintenance intervals depend on the installation and operating conditions.

Siemens offers its customers support in the form of service contracts. For further information, contact your Siemens regional office or sales office.

6.2 Commissioning after a long storage time

If the inverter was not operational for a longer period of time, it is possible that you must form the DC link capacitors before switching on.

Form the DC link capacitors in the following cases:

- If the inverter was not operational for longer than one year.
- If the date of manufacture of the inverter was more than one year ago when commissioning the drive system for the first time. The date of manufacture is coded in the serial number (see the next paragraph).

You form the DC link capacitors by connecting power to the inverters as shown below.

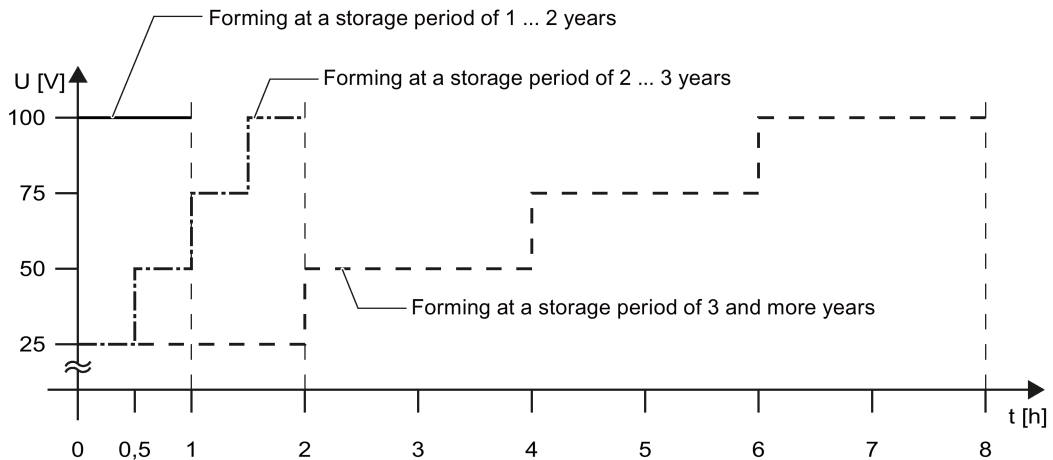


Figure 6-1 Forming the DC link capacitors

Data of manufacture of the inverter

The date of manufacture of the inverter is encrypted in positions 3 - 6 of the serial number.

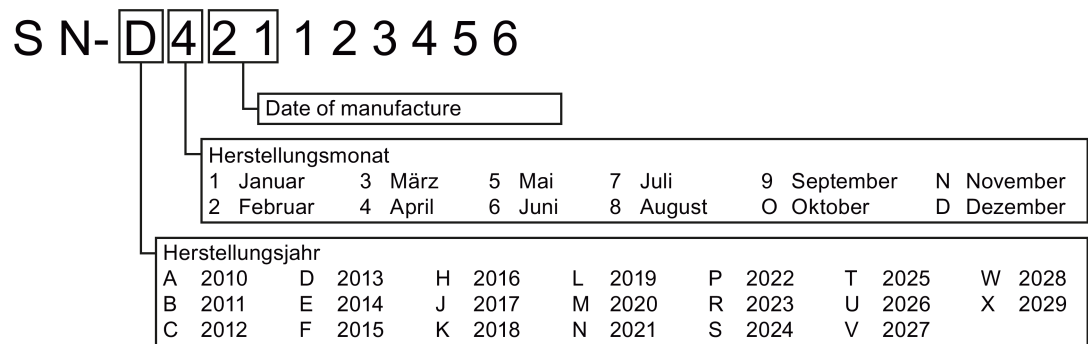


Figure 6-2 Data of manufacture in the serial number (example, April 21, 2013)

6.3 Replacing a fan

For frame sizes FSA ... FSC the fan module is installed at the bottom. For frame sizes FSD ... FSF it is located at the top.

Tools are not required to replace a fan. The electrical connections are disconnected or established by withdrawing or inserting the fan module.

For frame sizes FSA and FSB the fan module has one fan, for frame sizes FSC ... FSF, two fans.

Service life of the fan

The average service life of the fan is 40,000 hours. In practice, however, the service life may deviate from this value. Especially a dusty environment can block up the fan.

The fan must be replaced in good time to ensure that the inverter is ready for operation.

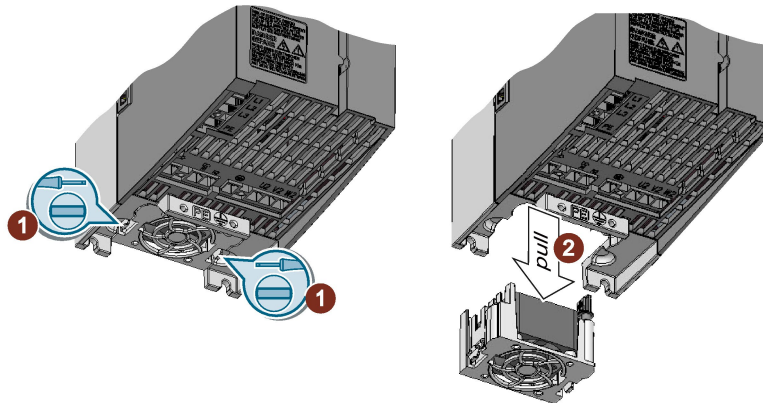
6.3.1 Fan replacement FSA ... FSC

Procedure when replacing fan modules FSA ... FSC



Proceed as follows to replace a fan module:

1. Switch-off the inverter, and wait 5 minutes until the DC link capacitors have been discharged.
2. Withdraw the line and motor cable connectors and, if available, remove the braking resistor from the Power Module.
3. Remove the shield plate from the Power Module.
4. Remove the fan module from the Power Module as shown in the diagram.



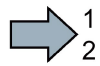
5. Install the new fan module in the inverse sequence.



You have replaced the fan module.

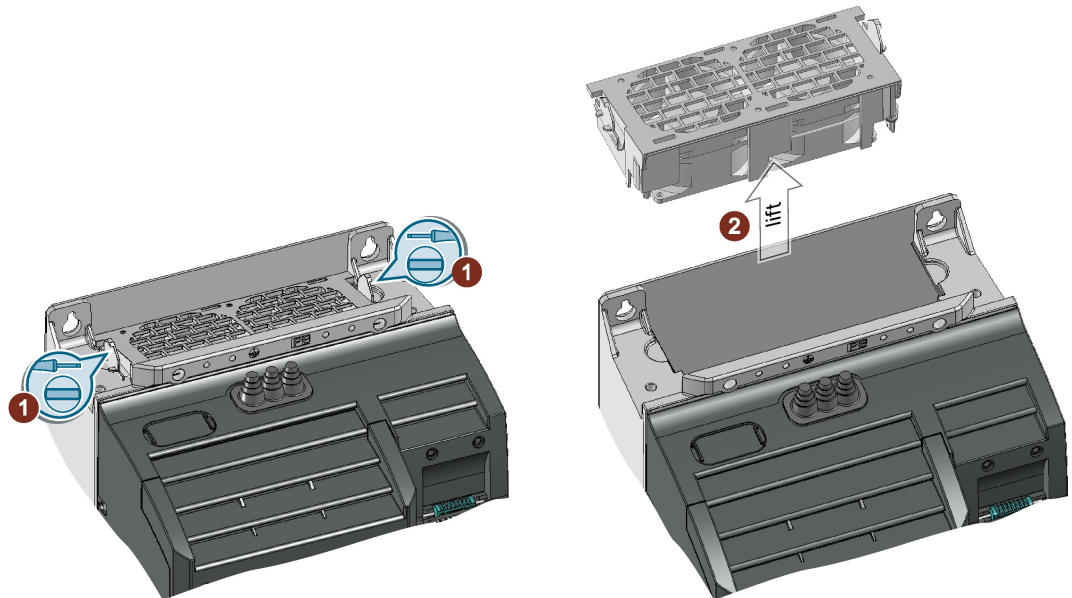
6.3.2 Fan replacement FSD ... FSF

Procedure for replacing the fan module FSD ... FSF



1 Proceed as follows to replace a fan module:

1. Switch-off the inverter, and wait 5 minutes until the DC link capacitors have been discharged.
2. Remove the fan module from the Power Module as shown in the diagram.



3. Install the new fan module in the inverse sequence.



You have replaced the fan module

Technical data

Permissible shock and vibration values

Vibration load

- Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1
- Transport in the transport packaging according to Class 2M3 to EN 60721-3-2

Shock load

- Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1
- Transport in the transport packaging according to Class 2M3 to EN 60721-3-2

Power loss of the Power Modules

Note

Power loss for Power Modules, FSA, FSB and FSC

The values specified for the power loss are typical values at 100% of the rated speed and 100% of the load corresponding to Low Overload.

Power loss for Power Modules FSD and FSF

The values specified for the power loss are typical values at 90% of the rated speed and 100% of the load corresponding to Low Overload.

7.1 High overload - low overload PM240-2

Typical inverter load cycles

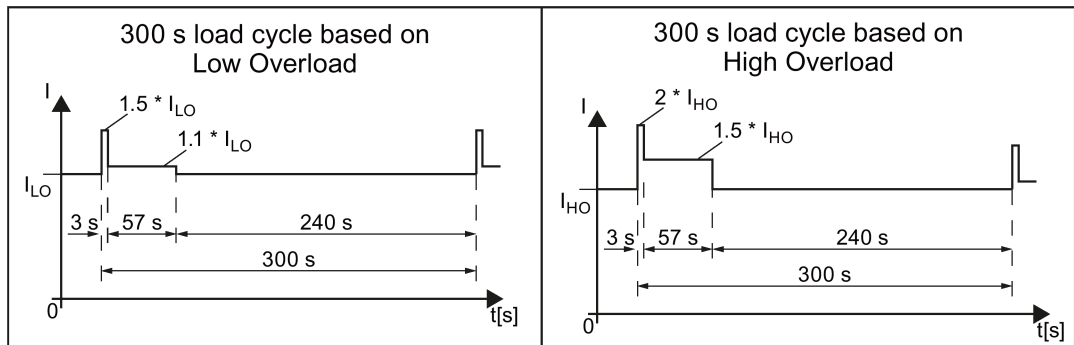


Figure 7-1 "Low Overload" and "High Overload" load cycles

Overload capability is the property of the inverter to temporarily supply a current that is higher than the rated current to accelerate a load. Two typical load cycles are defined to clearly demonstrate the overload capability: "Low Overload" and "High Overload"

Definitions

Base load

Constant load between the accelerating phases of the drive

Low Overload

- **LO base load input current**
Permissible input current for a "Low Overload" load cycle
- **LO base load output current**
Permissible output current for a "Low Overload" load cycle
- **LO base load power**
Rated power based on the LO base load output current

High Overload

- **HO base load input current**
Permissible input current for a "High Overload" load cycle
- **HO base load output current**
Permissible output current for a "High Overload" load cycle
- **HO base load power**
Rated power based on the HO base load output current

If not specified otherwise, the power and current data in the technical data always refer to a load cycle according to Low Overload.

We recommend the "SIZER" engineering software to select the inverter.



You will find additional information about SIZER on the Internet: Download SIZER (<http://support.automation.siemens.com/WW/view/en/10804987/130000>).

Load cycles and typical applications:**"Low Overload" load cycle**

The "Low Overload" load cycle assumes a uniform base load with low requirements placed on brief accelerating phases. Typical applications when designing according to "Low Overload" include:

- Pumps, fans and compressors
- Wet or dry blasting technology
- Mills, mixers, kneaders, crushers, agitators
- Basic spindles
- Rotary kilns
- Extruders










"High Overload" load cycle

The "High Overload" load cycle permits, for reduced base load, dynamic accelerating phases. Typical applications when designing according to "High Overload" include:

- Horizontal and vertical conveyor technology (conveyor belts, roller conveyors, chain conveyors)
- Centrifuges
- Escalators/moving stairways
- Lifters/Lowerers
- Elevators
- Gantry cranes
- Cable railways
- Storage and retrieval machines

7.2 Cable cross-sections and tightening torques

Table 7- 1 Connection type, cable cross sections and tightening torques

Inverters	Connection		Cross-section and tightening torque		Strip lengths
			Metric	Imperial	
FSA	Line, motor cable, DC link and braking resistor		1.5 ... 2.5 mm ² 0.5 Nm	16 ... 14 AWG: 4.5 lbf in	8 mm
FSB	Line, motor cable, DC link and braking resistor		1.5 ... 6 mm ² 0.6 Nm	16 ... 10 AWG: 5.5 lbf in	8 mm
FSC	Line, motor cable, DC link and braking resistor		6 ... 16 mm: 1.3 Nm	10 ... 6 AWG: 12 lbf in	10 mm
FSD	Line, motor cable and DC link		10 ... 35 mm ² : 2.5 ... 4.5 Nm	20 ... 10 AWG: 22 lbf in 8 ... 2 AWG: 40 lbf in	18 mm
	Braking resistor		2.5 ... 16 mm ² : 1.2 ... 1.5 Nm	20 ... 6 AWG: 15 lbf in	10 mm
FSE	Line, motor cable and DC link		25 ... 70 mm ² : 8 ... 10 Nm	6 ... 3/0 AWG: 88.5 lbf in	25 mm
	Braking resistor		10 ... 35 mm ² : 2.5 ... 4.5 Nm	20 ... 10 AWG: 22 lbf in 8 ... 2 AWG: 40 lbf in	18 mm
FSF	Line, motor cable and DC link with cable lugs according to SN71322		35 ... 2*120 mm ² : 22 ... 25 Nm	1 ... 2*4/0 AWG: 210 lbf.in	--
	Braking resistor		25 ... 70 mm ² : 8 ... 10 Nm	6 ... 3/0 AWG: 88.5 lbf in	25 mm


7.3 Technical data, 200 V inverters



Motors for 200 V Power Modules

For the 200 V Power Modules, induction motors are permissible in the range from 25 % ... 150 % of the inverter power without any restrictions.

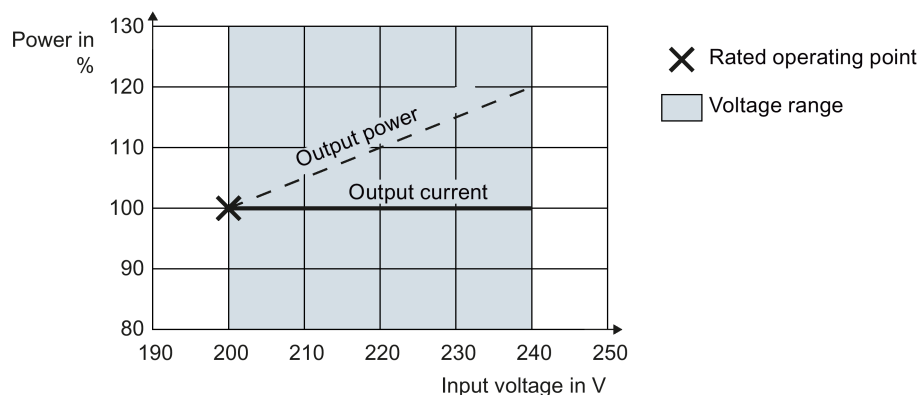
Use motors for inverter operation or with higher insulation levels.

7.3.1 General data, 200 V inverters

Property	Version		
Line voltage	FSA ... FSC	200 V ... 240 V 1-ph. AC ± 10 %	for LO base load power 0.55 kW ... 4 kW for HO base load power 0.37 kW ... 3 kW
		200 V ... 240 V 3-ph. AC ± 10 %	for LO base load power 0.55 kW ... 7.5 kW for HO base load power 0.37 kW ... 5.5 kW
	FSD ... FSF	200 V ... 240 V 3-ph. AC -20 % / + 10 %	
Output voltage	3 AC 0 V ... 0.95 x input voltage (max.)		
Input frequency	50 Hz ... 60 Hz, ± 3 Hz		
Output frequency	0 ... 550 Hz, depending on the control mode		
Line impedance	FSA ... FSC	U _k ≥ 2 %, for lower values, we recommend a line reactor, or a Power Module with the next higher power rating.	
	FSD ... FSF	Line reactor not required	
Power factor λ	FSA ... FSC	0.7 without line reactor for U _k ≥ 2 % 0.85 with line reactor for U _k < 2 %	
	FSD ... FSF	0.95 line reactor not required	
Inrush current	< LO base load input current		
Overvoltage category acc. to EN 60664-1	The inverter insulation is designed for surge voltages according to overvoltage Category III.		
Pulse frequency	4 kHz (factory setting), Adjustable as follows in 2 kHz steps: • 4 kHz ... 16 kHz for devices from 0.55 kW ... 30 kW. • 4 kHz ... 8 kHz for devices 36 kW and higher If you increase the pulse frequency, the inverter reduces the maximum output current.		
Short-circuit current rating (SCCR)	FSA ... FSC	≤ 100 kA rms	
	FSD ... FSF	≤ 65 kA rms	
	 Branch protection and short-circuit strength according to UL and IEC https://support.industry.siemens.com/cs/ww/en/view/109479152		
Electromagnetic compatibility according to IEC/EN 61800-3	Devices with integrated filter are suitable for Category C2 environments.		
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper		


Property	Version	
Degree of protection according to EN 60529	Chassis devices PT devices	IP20 IP20, IP54 Must be installed in a control cabinet Must be installed in a control cabinet at the control cabinet panel
Ambient temperature	FSA ... FSC: LO base load power without derating: HO base load power without derating: LO/HO base load power with derating:	-10 °C ... +40 °C -10 °C ... +50 °C -10 °C ... + 60° C
	FSD ... FSF: LO base load power without derating: HO base load power without derating: LO/HO base load power with derating:	-20 °C ... +40 °C -20 °C ... +50 °C -20 °C ... + 60° C
	 Restrictions for special ambient conditions (Page 92) For the maximum permissible ambient temperature, also observe the permissible ambient temperatures for the Control Unit and possibly operator panel (IOP or BOP-2) .	
Ambient conditions according to EN 60721-3-3	FSA ... FSC FSD ... FSF	Protected against damaging chemical substance, according to environmental Class 3C2 Protected against damaging chemical substance, according to environmental Class 3C3
Temperature during storage according to EN 60721-3-3	-40 °C ... +70 °C	
Cooling air	clean and dry air	
Relative humidity	< 95%	
Pollution according to EN 61800-5-1	suitable for environments with degree of pollution 2, condensation not permissible	
Shocks and vibration according to EN 60721-3-1	<ul style="list-style-type: none"> • Long-term storage in the transport packaging according to Class 1M2 • Transport in the transport packaging according to Class 2M3 • Vibration in operation according to Class 3M2 	
Installation altitude	without derating with derating	up to 1000 m above sea level up to 4000 m above sea level
	 Restrictions for special ambient conditions (Page 92)	
Approvals	FSA ... FSC FSD ... FSF	cULus, CE, C-tick, KCC cULus, CE, C-tick, SEMI F47, KCC, WEEE, RoHS, EAC

Dependent on the input voltage and output power 200 V inverters



7.3.2 Specific technical data, 200 V inverters

The fuses listed in the following tables are examples of suitable fuses.

Additional components for branch protection:  Branch protection and short-circuit strength according to UL and IEC

<https://support.industry.siemens.com/cs/ww/en/view/109479152>

Table 7- 2 PM240-2, IP20, frame sizes A, 1 AC / 3 AC 200 V ... 240 V

Article No. - without filter	6SL3210...	...1PB13-0UL0	...1PB13-8UL0
Article No. - with filter	6SL3210...	...1PB13-0AL0	...1PB13-8AL0
LO base load power		0.55 kW	0.75 kW
LO base load input current 1 AC		7.5 A	9.6 A
LO base load input current 3 AC		4.2 A	5.5 A
LO base load output current		3.2 A	4.2 A
HO base load power		0.37 kW	0.55 kW
HO base load input current 1 AC		6.6 A	8.4 A
HO base load input current 3 AC		3.0 A	4.2 A
HO base load output current		2.3 A	3.2 A
Fuse according to IEC		3NA3 803 (10 A)	3NA3 805 (16 A)
Fuse according to UL		15 A Class J	15 A Class J
Power losses without filter		0.04 kW	0.04 kW
Power losses with filter		0.04 kW	0.04 kW
Required cooling air flow		5 l/s	5 l/s
Weight without filter		1.4 kg	1.4 kg
Weight with filter		1.6 kg	1.6 kg

Technical data

7.3 Technical data, 200 V inverters

Table 7- 3 PM240-2, PT, frame sizes A, 1 AC / 3 AC 200 V ... 240 V

Article No. - without filter	6SL3211...	...1PB13-8UL0
Article No. - with filter	6SL3211...	...1PB13-8AL0
LO base load power		0.75 kW
LO base load input current 1 AC		9.6 A
LO base load input current 3 AC		5.5 A
LO base load output current		4.2 A
HO base load power		0.55 kW
HO base load input current 1 AC		8.4 A
HO base load input current 3 AC		4.2 A
HO base load output current		3.2 A
Fuse according to IEC		3NA3 805 (16 A)
Fuse according to UL		15 A Class J
Power losses without filter		0.04 kW
Power losses with filter		0.04 kW
Required cooling air flow		5 l/s
Weight without filter		1.8 kg
Weight with filter		2.0 kg

Table 7- 4 PM240-2, IP20, frame sizes B, 1 AC / 3 AC 200 V ... 240 V

Article No. - without filter	6SL3210...	...1PB15-5UL0	...1PB17-4UL0	...1PB21-0UL0
Article No. - with filter	6SL3210...	...1PB15-5AL0	...1PB17-4AL0	...1PB21-0AL0
LO base load power		1.1 kW	1.5 kW	2.2 kW
LO base load input current 1 AC		13.5 A	18.1 A	24.0 A
LO base load input current 3 AC		7.8 A	9.7 A	13.6 A
LO base load output current		6 A	7.4 A	10.4 A
HO base load power		0.75 kW	1.1 kW	1.5 kW
HO base load input current 1 AC		11.8 A	15.8 A	20.9 A
HO base load input current 3 AC		5.5 A	7.8 A	9.7 A
HO base load output current		4.2 A	6 A	7.4 A
Fuse according to IEC		3NE 1814-0 (20 A)	3NE 1815-0 (25 A)	3NE 1803-0 (35 A)
Fuse according to UL		35 A Class J	35 A Class J	35 A Class J
Power losses without filter		0.05 kW	0.07 kW	0.12 kW
Power losses with filter		0.05 kW	0.07 kW	0.12 kW
Required cooling air flow		9.2 l/s	9.2 l/s	9.2 l/s
Weight without filter		2.8 kg	2.8 kg	2.8 kg
Weight with filter		3.1 kg	3.1 kg	3.1 kg

Table 7- 5 PM240-2, PT, frame sizes B, 1 AC / 3 AC 200 V ... 240 V

Article No. - without filter	6SL3211...	...1PB21-0UL0
Article No. - with filter	6SL3211...	...-1PB21-0AL0
LO base load power		2.2 kW
LO base load input current 1 AC		24.0 A
LO base load input current 3 AC		13.6 A
LO base load output current		10.4 A
HO base load power		1.5 kW
HO base load input current 1 AC		20.9 A
HO base load input current 3 AC		9.7 A
HO base load output current		7.4 A
Fuse according to IEC		3NE 1803-0 (35 A)
Fuse according to UL		35 A Class J
Power losses without filter		0.12 kW ¹⁾
Power losses with filter		0.12 kW ¹⁾
Required cooling air flow		9.2 l/s
Weight without filter		3.4 kg
Weight with filter		3.7 kg

1) approx. 0.08 through the heatsink

Table 7- 6 PM240-2, IP 20, frame sizes C, 1 AC / 3 AC 200 V ... 240 V

Article No. - without filter	6SL3210...	...1PB21-4UL0	...1PB21-8UL0
Article No. - with filter	6SL3210...	...1PB21-4AL0	...1PB21-8AL0
LO base load power		3 kW	4 kW
LO base load input current 1 AC		35.9 A	43.0 A
LO base load input current 3 AC		17.7 A	22.8 A
LO base load output current		13.6 A	17.5 A
HO base load power		2.2 kW	3 kW
HO base load input current 1 AC		31.3 A	37.5 A
HO base load input current 3 AC		13.6 A	17.7 A
HO base load output current		10.4 A	13.6 A
Fuse according to IEC		3NE 1817-0 (50 A)	3NE 1818-0 (63 A)
Fuse according to UL		50 A Class J	50 A Class J
Power losses without filter		0.14 kW	0.18 kW
Power losses with filter		0.14 kW	0.18 kW
Required cooling air flow		18.5 l/s	18.5 l/s
Weight without filter		5.0 kg	5.0 kg
Weight with filter		5.2 kg	5.2 kg

Technical data

7.3 Technical data, 200 V inverters

Table 7- 7 PM240-2, PT, frame sizes C, 1 AC / 3 AC 200 V ... 240 V

Article No. - without filter	6SL3211...	...1PB21-8UL0
Article No. - with filter	6SL3211...	...1PB21-8AL0
LO base load power		4 kW
LO base load input current 1 AC		43.0 A
LO base load input current 3 AC		22.8 A
LO base load output current		17.5 A
HO base load power		3 kW
HO base load input current 1 AC		37.5 A
HO base load input current 3 AC		17.7 A
HO base load output current		13.6 A
Fuse according to IEC		3NE 1818-0 (63 A)
Fuse according to UL		50 A Class J
Power losses without filter		0.18 kW ¹⁾
Power losses with filter		0.18 kW ¹⁾
Required cooling air flow		18.5 l/s
Weight without filter		5.9 kg
Weight with filter		6.2 kg

1) approx. 0.09 through the heatsink

Table 7- 8 PM240-2, IP 20, frame sizes C, 3 AC 200 V ... 240 V

Article No. - without filter	6SL3210...	...1PC22-2UL0	...1PC22-8UL0
Article No. - with filter	6SL3210...	...1PC22-2AL0	...1PC22-8AL0
LO base load power		5.5 kW	7.5 kW
LO base load input current		28.6 A	36.4 A
LO base load output current		22.0 A	28.0 A
HO base load power		4 kW	5.5 kW
HO base load input current		22.8 A	28.6 A
HO base load output current		17.5 A	22.0 A
Fuse according to IEC		3NE 1802-0 (40 A)	3NE 1817-0 (50 A)
Fuse according to UL		50 A Class J	50 A Class J
Power losses without filter		0.2 kW	0.26 kW
Power losses with filter		0.2 kW	0.26 kW
Required cooling air flow		18.5 l/s	18.5 l/s
Weight without filter		5.0 kg	5.0 kg
Weight with filter		5.2 kg	5.2 kg

Table 7- 9 PM240-2, IP20, FSD, 3 AC 200 V ... 240 V

Article No. - without filter	6SL3210-...	...1PC24-2UL0	...1PC25-4UL0	...1PC26-8UL0
LO base load power		11 kW	15 kW	18.5 kW
LO base load input current		40 A	51 A	64 A
LO base load output current		42 A	54 A	68 A
HO base load power		7.5 kW	11 kW	15 kW
HO base load input current		36 A	43 A	56 A
HO base load output current		35 A	42 A	54 A
Siemens fuse according to IEC/UL		3NE1818-0 / 63A	3NE1 820-0 / 80A	3NE1 021-0 / 100A
Fuse according to IEC/UL, Class J		60 A	70 A	90 A
Power loss		0.42 kW	0.57 kW	0.76 kW
Required cooling air flow		55 l/s	55 l/s	55 l/s
Weight		17 kg	17 kg	17 kg

Table 7- 10 PM240-2, IP20, FSE, 3 AC 200 V ... 240 V

Article No. - without filter	6SL3210-...	...1PC28-8UL0	...1PC31-1UL0
LO base load power		22 kW	30 kW
LO base load input current		76 A	98 A
LO base load output current		80 A	104 A
HO base load power		18.5 kW	22 kW
HO base load input current		71 A	83 A
HO base load output current		68 A	80 A
Siemens fuse according to IEC/UL		3 NE1 021-0 / 100A	3 NE1 224-0 / 160A
Fuse according to IEC/UL, Class J		100 A	150 A
Power loss		0.85 kW	1.20 kW
Required cooling air flow		83 l/s	83 l/s
Weight		26 kg	26 kg

Table 7- 11 PM240-2, IP20, FSF, 3 AC 200 V ... 240 V

Article No. - without filter	6SL3210-...	...1PC31-3UL0	...1PC31-6UL0	...1PC31-8UL0
LO base load power		37 kW	45 kW	55 kW
LO base load input current		126 A	149 A	172 A
LO base load output current		130 A	154 A	178 A
HO base load power		30 kW	37 kW	45 kW
HO base load input current		110 A	138 A	164 A
HO base load output current		104 A	130 A	154 A
Siemens fuse according to IEC/UL		3 NE1 225-0 / 200A	3 NE1 225 -0 / 200A	3 NE1 227-0 / 250A
Fuse according to IEC/UL, Class J		175 A	200 A	225 A
Power loss		1.44 kW	1.79 kW	2.18 kW
Required cooling air flow		153 l/s	153 l/s	153 l/s
Weight		57 kg	57 kg	57 kg

7.3.3 Current derating depending on the pulse frequency, 200 V inverters

Article number	LO base load output current for a pulse frequency of ... [A]						
	2 kHz / 4 kHz	6 kHz	8 kHz	10 kHz	12 kHz	14 kHz	16 kHz
6SL3210-1PB13-0□L0	3.2	2.6	2.1	1.8	1.5	1.4	1.2
6SL321□-1PB13-8□L0	4.2	3.3	2.7	2.3	2.0	1.8	1.6
6SL3211-1PB15-5□L0	6.0	4.7	3.9	3.3	2.8	2.5	2.2
6SL3210-1PB17-4□L0	7.4	6.3	5.2	4.4	3.7	3.3	3.0
6SL321□-1PB21-0□L0	10.4	8.8	7.3	6.2	5.2	4.7	4.2
6SL3210-1PB21-4□L0	13.6	11.6	9.5	8.2	6.8	6.1	5.4
6SL321□-1PB21-8□L0	17.5	14.9	12.3	10.5	8.8	7.9	7.0
6SL3210-1PC22-2□L0	22.0	18.7	15.4	13.2	11.0	9.9	8.8
6SL3210-1PC22-8□L0	28.0	23.8	19.6	16.8	14.0	12.6	11.2
6SL3210-1PC24-2□L0	42	35.7	29.4	25.2	21.0	18.9	16.8
6SL3210-1PC25-4□L0	54	45.9	37.8	32.4	27.0	24.3	21.6
6SL3210-1PC26-8□L0	68	57.8	47.6	40.8	34.0	30.6	27.2
6SL3210-1PC28-8□L0	80	68.0	56.0	48.0	40.0	36.0	32.0
6SL3210-1PC31-1□L0	104	88.4	72.8	62.4	52.0	46.8	41.6
6SL3210-1PC31-3□L0	130	110.5	91.0	---	---	---	---
6SL3210-1PC31-6□L0	154	130.9	107.8	---	---	---	---
6SL3210-1PC31-8□L0	178	151.3	124.6	---	---	---	---

The permissible motor cable length depends on the particular cable type and the pulse frequency that has been selected


7.4 Technical data, 400 V inverters



Motors for 400 V Power Modules

For the 400 V Power Modules, induction motors are permissible in the range from 25 % ... 150 % of the inverter power without any restrictions.

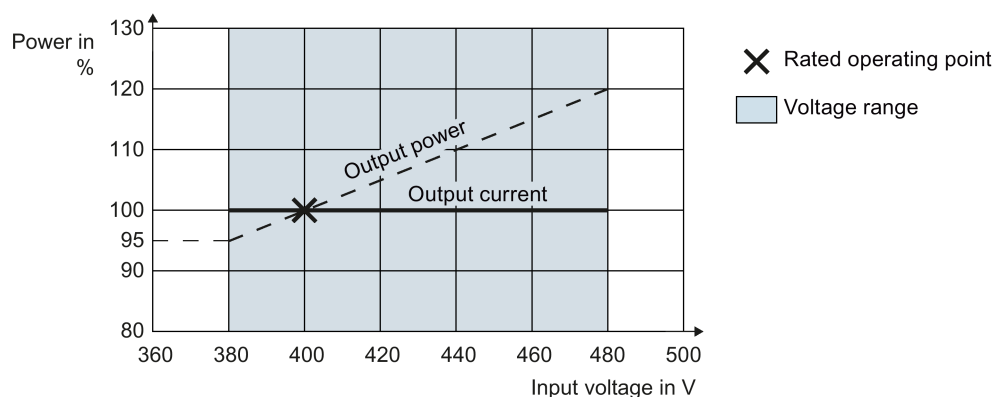
Use motors for inverter operation or with higher insulation levels.

7.4.1 General data, 400 V inverters

Property	Version
Line voltage	FSA ... FSC 380 V ... 480 V 3-ph. AC \pm 10 %
	FSD ... FSF 3 AC 380 V ... 480 V -20 %, +10 %
Output voltage	3 AC 0 V ... 0.95 x input voltage (max.)
Input frequency	50 Hz ... 60 Hz, \pm 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Line impedance	FSA ... FSC $U_k \geq 1$ %, for lower values, we recommend a line reactor, or a Power Module with the next higher power rating.
	FSD ... FSF Line reactor not required
Power factor λ	FSA ... FSC 0.7 without line reactor for $U_k \geq 1$ % 0.85 with line reactor for $U_k < 1$ %
	FSD ... FSF 0.95 line reactor not required
Inrush current	< LO base load input current
Overvoltage category acc. to EN 60664-1	The inverter insulation is designed for surge voltages according to overvoltage Category III.
Pulse frequency	Factory setting
	<ul style="list-style-type: none"> • 4 kHz for devices with an LO base load power < 75 kW • 2 kHz for devices with an LO base load power \geq 75 kW Can be adjusted in 2 kHz steps as follows: <ul style="list-style-type: none"> • 2 kHz ... 16 kHz for devices with an LO base load power < 55 kW • 2 kHz ... 8 kHz for devices with an LO base load power \geq 55 kW If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current rating (SCCR)	FSA ... FSC \leq 100 kA rms
	FSD ... FSF \leq 65 kA rms
	 Branch protection and short-circuit strength according to UL and IEC https://support.industry.siemens.com/cs/ww/en/view/109479152
Electromagnetic compatibility according to IEC/EN 61800-3	Devices with integrated filter are suitable for Category C2 environments.
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper


Property	Version	
Degree of protection according to EN 60529	Chassis devices PT devices	IP20 IP20, IP54 Must be installed in a control cabinet Must be installed in a control cabinet at the control cabinet panel
Ambient temperature	FSA ... FSC: LO base load power without derating: HO base load power without derating: LO/HO base load power with derating:	-10 °C ... +40 °C -10 °C ... +50 °C -10 °C ... + 60° C
	FSD ... FSF: LO base load power without derating: HO base load power without derating: LO/HO base load power with derating:	-20 °C ... +40 °C -20 °C ... +50 °C -20 °C ... + 60° C
	 Restrictions for special ambient conditions (Page 92) For the maximum permissible ambient temperature, also observe the permissible ambient temperatures for the Control Unit and possibly operator panel (IOP or BOP-2) .	
Ambient conditions according to EN 60721-3-3	FSA ... FSC: FSD ... FSF	Protected against damaging chemical substance, according to environmental Class 3C2 Protected against damaging chemical substance, according to environmental Class 3C3
Temperature during storage according to EN 60721-3-3	-40 °C ... +70 °C	
Cooling air	clean and dry air	
Relative humidity	< 95%	
Pollution according to EN 61800-5-1	suitable for environments with degree of pollution 2, condensation not permissible	
Shocks and vibration according to EN 60721-3-1	<ul style="list-style-type: none"> • Long-term storage in the transport packaging according to Class 1M2 • Transport in the transport packaging according to Class 2M3 • Vibration in operation according to Class 3M2 	
Installation altitude	without derating: with derating:	up to 1000 m above sea level up to 4000 m above sea level
	 Restrictions for special ambient conditions (Page 92)	
Approvals	FSA ... FSC FSD ... FSF	cULus, CE, C-tick, KCC cULus, CE, C-tick, SEMI F47, KCC, WEEE, RoHS, EAC

Dependent on the input voltage and output power 400 V inverters



7.4.2 Specific technical data, 400 V inverters

The fuses listed in the following tables are examples of suitable fuses.

Additional components for branch protection:  Branch protection and short-circuit strength according to UL and IEC

<https://support.industry.siemens.com/cs/ww/en/view/109479152>

Table 7- 12 PM240-2, IP20, frame sizes A, 3-phase 380 ... 480 VAC

Article no. - without filter	6SL3210...	...1PE11-8UL1	...1PE12-3UL1	...1PE13-2UL1
Article no. - with filter	6SL3210...	...1PE11-8AL1	...1PE12-3AL1	...1PE13-2AL1
LO base load power		0.55 kW	0.75 kW	1.1 kW
LO base load input current		2.3 A	2.9 A	4.1 A
LO base load output current		1.7 A	2.2 A	3.1 A
HO base load power		0.37 kW	0.55 kW	0.75 kW
HO base load input current		2.0 A	2.6 A	3.3 A
HO base load output current		1.3 A	1.7 A	2.2 A
Fuse according to IEC		3NA3 804 (4 A)	3NA3 804 (4 A)	3NA3 801 (6 A)
Fuse according to UL		10 A Class J	10 A Class J	15 A Class J
Power loss		0.04 kW	0.04 kW	0.04 kW
Required cooling air flow		5 l/s	5 l/s	5 l/s
Weight without filter		1.3 kg	1.3 kg	1.3 kg
Weight with filter		1.5 kg	1.5 kg	1.5 kg

Technical data

7.4 Technical data, 400 V inverters

Table 7- 13 PM240-2, IP20, frame sizes A, 3-phase 380 ... 480 VAC

Article no. - without filter	6SL3210...	...1PE14-3UL1	...1PE16-1UL1	...1PE18-0UL1
Article no. - with filter	6SL3210...	...1PE14-3AL1	...1PE16-1AL1	...1PE18-0AL1
LO base load power		1.5 kW	2.2 kW	3.0 kW
LO base load input current		5.5 A	7.7 A	10.1 A
LO base load output current		4.1 A	5.9 A	7.7 A
HO base load power		1.1 kW	1.5 kW	2.2 kW
HO base load input current		4.7 A	6.1 A	8.8 A
HO base load output current		3.1 A	4.1 A	5.9 A
Fuse according to IEC		3NA3 803 (10 A)	3NA3 803 (10 A)	3NA3 805 (16 A)
Fuse according to UL		20 A Class J	30 A Class J	30 A Class J
Power loss		0.07 kW	0.1 kW	0.12 kW
Required cooling air flow		5 l/s	5 l/s	5 l/s
Weight without filter		1.4 kg	1.4 kg	1.4 kg
Weight with filter		1.6 kg	1.6 kg	1.6 kg

Table 7- 14 PM240-2, PT, frame sizes A, 3-phase 380 ... 480 VAC

Article no. - without filter	6SL3211...	...1PE18-0UL1
Article no. - with filter	6SL3211...	...1PE18-0AL1
LO base load power		3.0 kW
LO base load input current		10.1 A
LO base load output current		7.7 A
HO base load power		2.2 kW
HO base load input current		8.8 A
HO base load output current		5.9 A
Fuse according to IEC		3NA3 805 (16 A)
Fuse according to UL		30 A Class J
Power loss without filter		0.12 kW ¹⁾
Required cooling air flow		7 l/s
Weight without filter		1.8 kg
Weight with filter		2.0 kg

1) approx. 0.1 kW through the heatsink

Table 7- 15 PM240-2, IP20, frame sizes B, 3-phase 380 ... 480 VAC

Article no. - without filter	6SL3210...	...1PE21-1UL0	...1PE21-4UL0	...1PE21-8UL0
Article no. - with filter	6SL3210...	...1PE21-1AL0	...1PE21-4AL0	...1PE21-8AL0
LO base load power		4.0 kW	5.5 kW	7.5 kW
LO base load input current		13.3 A	17.2 A	22.2 A
LO base load output current		10.2 A	13.2 A	18.0 A
HO base load power		3.0 kW	4.0 kW	5.5 kW
HO base load input current		11.6 A	15.3 A	19.8 A
HO base load output current		7.7 A	10.2 A	13.2 A
Fuse according to IEC		3NE 1814-0 (20 A)	3NE 1815-0 (25 A)	3NE 1803-0 (35 A)
Fuse according to UL		35 A Class J	35 A Class J	35 A Class J
Power loss		0.11 kW	0.15 kW	0.2 kW
Required cooling air flow		9.2 l/s	9.2 l/s	9.2 l/s
Weight without filter		2.9 kg	2.9 kg	3.0 kg
Weight with filter		3.1 kg	3.1 kg	3.2 kg

Table 7- 16 PM240-2, PT, frame sizes B, 3-phase 380 ... 480 VAC

Article no. - without filter	6SL3211...	...1PE21-8UL0
Article no. - with filter	6SL3211...	...1PE21-8AL0
LO base load power		7.5 kW
LO base load input current		22.2 A
LO base load output current		18.0 A
HO base load power		5.5 kW
HO base load input current		19.8 A
HO base load output current		13.7 A
Fuse according to IEC		3NE 1803-0 (35 A)
Fuse according to UL		35 A Class J
Power loss		0.2 kW ¹⁾
Required cooling air flow		9.2 l/s
Weight without filter		3.6 kg
Weight with filter		3.9 kg

1) approx. 0.16 kW through the heatsink;

7.4 Technical data, 400 V inverters

Table 7- 17 PM240-2, IP20, frame sizes C, 3-phase 380 ... 480 VAC

Article no. - without filter	6SL3210...	...1PE22-7UL0	...1PE23-3UL0
Article no. - with filter	6SL3210...	...1PE22-7AL0	...1PE23-3AL0
LO base load power		11.0 kW	15.0 kW
LO base load input current		32.6 A	39.9 A
LO base load output current		26.0 A	32.0 A
HO base load power		7.5 kW	11.0 kW
HO base load input current		27.0 A	36.0 A
HO base load output current		18.0 A	26.0 A
Fuse according to IEC		3NE 1817-0 (50 A)	3NE 1817-0 (50 A)
Fuse according to UL		50 A Class J	50 A Class J
Power loss		0.3 kW	0.37 kW
Required cooling air flow		18.5 l/s	18.5 l/s
Weight without filter		4.7 kg	4.8 kg
Weight with filter		5.3 kg	5.4 kg

Table 7- 18 PM240-2, PT, frame sizes C, 3-phase 380 ... 480 VAC

Article no. - without filter	6SL3211...	...1PE23-3UL0
Article no. - with filter	6SL3211...	...1PE23-3AL0
LO base load power		15.0 kW
LO base load input current		39.9 A
LO base load output current		32.0 A
HO base load power		11.0 kW
HO base load input current		36.0 A
HO base load output current		26.0 A
Fuse according to IEC		3NE 1817-0 (50 A)
Fuse according to UL		50 A Class J
Power loss		0.37 kW ¹⁾
Required cooling air flow		18.5 l/s
Weight without filter		5.8 kg
Weight with filter		6.3 kg

1) approx. 0.3 kW through the heatsink;

Table 7- 19 PM240-2, IP20, FSD, 3 AC 380 V ... 480 V

Article No. - without filter	6SL3210-...	...1PE23-8UL0	...1PE24-5UL0	...1PE26-0UL0
Article No. - with filter	6SL3210-...	...1PE23-8AL0	...1PE24-5AL0	...1PE26-0AL0
LO base load power		18.5 kW	22 kW	30 kW
LO base load input current		36 A	42 A	57 A
LO base load output current		38 A	45 A	60 A
HO base load power		15 kW	18.5 kW	22 kW
HO base load input current		33 A	38 A	47 A
HO base load output current		32 A	38 A	45 A
Siemens fuse according to IEC/UL		3NE1 818-0 / 63 A	3NE1 820-0 / 80 A	3NE1 021-0 / 100A
Fuse according to IEC/UL, Class J		60 A	70 A	90 A
Power loss without filter		0.55 kW	0.68 kW	0.76 kW
Power loss with filter		0.56 kW	0.68 kW	0.77 kW
Required cooling air flow		55 l/s	55 l/s	55 l/s
Weight without filter		16 kg	16 kg	17 kg
Weight with filter		17.5 kg	17.5 kg	18.5 kg

Table 7- 20 PM240-2, IP20, FSD, 3 AC 380 V ... 480 V

Article No. - without filter	6SL3210-...	...1PE27-5UL0
Article No. - with filter	6SL3210-...	...1PE27-5AL0
LO base load power		37 kW
LO base load input current		70 A
LO base load output current		75 A
HO base load power		30 kW
HO base load input current		62 A
HO base load output current		60 A
Siemens fuse according to IEC/UL		3NE1 021-0 / 100 A
Fuse according to IEC/UL, Class J		100 A
Power loss without filter		1.01 kW
Power loss with filter		1.02 kW
Required cooling air flow		55 l/s
Weight without filter		17 kg
Weight with filter		18.5 kg

7.4 Technical data, 400 V inverters

Table 7- 21 PM240-2, IP20, FSE, 3 AC 380 V ... 480 V

Article No. - without filter	6SL3210-...	...1PE28-8UL0	...1PE31-1UL0
Article No. - with filter	6SL3210-...	...1PE28-8AL0	...1PE31-1AL0
LO base load power		45 kW	55 kW
LO base load input current		86 A	104 A
LO base load output current		90 A	110 A
HO base load power		37 kW	45 kW
HO base load input current		78 A	94 A
HO base load output current		75 A	90 A
Siemens fuse according to IEC/UL		3NE1 022-0 / 125A	3NE1 224-0 / 160A
Fuse according to IEC/UL, Class J		125 A	150 A
Power losses without filter		1.19 kW	1.54 kW
Power losses with filter		1.2 kW	1.55 kW
Required cooling air flow		83 l/s	83 l/s
Weight without filter		26kg	26 kg
Weight with filter		28 kg	28 kg

Table 7- 22 PM240-2, IP20, FSF, 3 AC 380 V ... 480 V

Article No. - without filter	6SL3210-...	...1PE31-5UL0	...1PE31-8UL0	...1PE32-1UL0
Article No. - with filter	6SL3210-...	...1PE31-5AL0	...1PE31-8AL0	...1PE32-1AL0
LO base load power		75 kW	90 kW	110 kW
LO base load input current		140 A	172 A	198 A
LO base load output current		145 A	178 A	205 A
HO base load power		55 kW	75 kW	90 kW
HO base load input current		117 A	154	189 A
HO base load output current		110 A	145 A	178 A
Siemens fuse according to IEC/UL		3NE1 225-0 / 200 A	3NE1 227-0 / 250 A	3NE1 230-0 / 315 A
Fuse according to IEC/UL, Class J		200 A	250 A	300 A
Power loss without filter		1.95 kW	2.54 kW	2.36 kW
Power loss with filter		1.97 kW	2.56 kW	2.38 kW
Required cooling air flow		153 l/s	153 l/s	153 l/s
Weight without filter		57 kg	57 kg	61 kg
Weight with filter		63 kg	63 kg	65 kg

Table 7- 23 PM240-2, IP20, FSF, 3 AC 380 V ... 480 V

Article No. - without filter	6SL3210-...	...1PE32-5UL0
Article No. - with filter	6SL3210-...	...1PE32-5AL0
LO base load power		132 kW
LO base load input current		242 A
LO base load output current		250 A
HO base load power		110 kW
HO base load input current		218 A
HO base load output current		205 A
Siemens fuse according to IEC/UL	3NE1	331-0 / 350 A
Fuse according to IEC/UL, Class J		350 A
Power loss without filter		3.09 kW
Power loss with filter		3.12 kW
Required cooling air flow		153 l/s
Weight without filter		61 kg
Weight with filter		65 kg

7.4.3 Current derating depending on the pulse frequency, 400 V inverters

Article number	LO base load output current for a pulse frequency of ... [A]						
	2 KHz / 4 kHz	6 kHz	8 kHz	10 kHz	12 kHz	14 kHz	16 kHz
6SL3210-1PE11-8□L1	1.7	1.4	1.2	1	0.9	0.8	0.7
6SL3210-1PE12-3□L1	2.2	1,9	1.5	1.3	1.1	1	0.9
6SL3211-1PE13-2□L1	3.1	2.6	2.2	1,9	1.6	1.4	1.2
6SL3210-1PE14-3□L1	4.1	3.5	2.9	2.5	2.1	1.8	1.6
6SL3210-1PE16-1□L1	5.9	5	4.1	3.5	3	2.7	2.4
6SL321□-1PE18-0□L1	7.7	6.5	5.4	4.6	3.9	3.5	3.1
6SL3210-1PE21-1□L0	10.2	8.7	7.1	6.1	5.1	4.6	4.1
6SL3210-1PE21-4□L0	13.2	11.2	9.2	7.9	6.6	5.9	5.3
6SL321□-1PE21-8□L0	18	15.3	12.6	10.8	9	8.1	7.2
6SL3210-1PE22-7□L0	26	22.1	18.2	15.6	13	11.7	10.4
6SL321□-1PE23-3□L0	32	27.2	22.4	19.2	16	14.4	12.8
6SL3210-1PE23-8□L0	38	32.3	26.6	22.8	19	17.1	15.2
6SL3210-1PE24-5□L0	45	38.3	31.5	27	22.5	20.3	18
6SL3210-1PE26-0□L0	60	51	42	36	30	27	24
6SL3210-1PE27-5□L0	75	63.8	52.5	45	37.5	33.8	30
6SL3210-1PE28-8□L0	90	76.5	63	54	45	40.5	36
6SL3210-1PE31-1□L0	110	93.5	77	66	55	49.5	44
6SL3210-1PE31-5□L0	145	123.25	108.75	---	---	---	---
6SL3210-1PE31-8□L0	178	151.3	133.5	---	---	---	---
6SL3210-1PE32-1□L0	205	---	---	---	---	---	---
6SL3210-1PE32-5□L0	250	---	---	---	---	---	---

The permissible motor cable length depends on the particular cable type and the pulse frequency that has been selected



7.5 Technical data, 690 V inverters


Motors for 690 V Power Modules

For the 690 V Power Modules, induction motors are permissible in the range from 50 % ... 150 % of the inverter power without any restrictions.

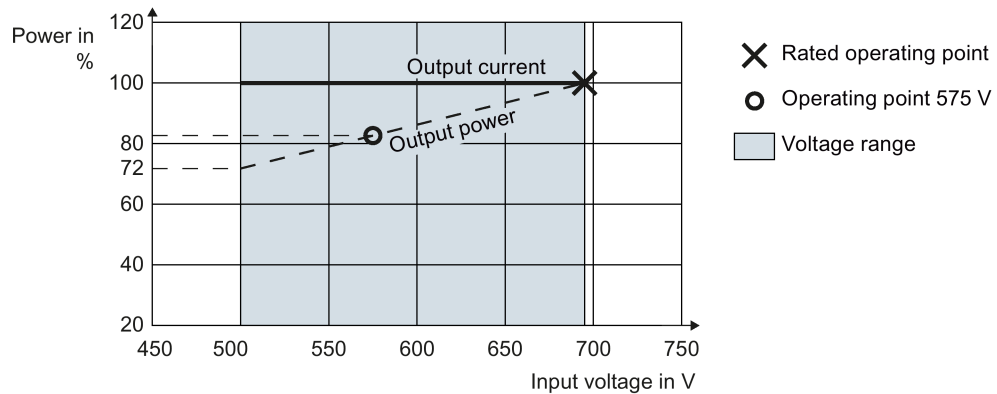
Use motors for inverter operation or with higher insulation levels.

7.5.1 General data, 690 V inverters

Property	Version
Line voltage	3 AC 500 V ... 690 V - 20 % ... +10 % (with fuses, Class J maximum 600 V)
Output voltage	3 AC 0 V ... 0.95 × input voltage (max.)
Input frequency	50 Hz ... 60 Hz, ± 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Power factor λ	> 0.9 line reactor not required
Inrush current	< LO base load input current
Overvoltage category acc. to EN 60664-1	The inverter insulation is designed for surge voltages according to overvoltage Category III.
Pulse frequency	2 kHz (factory setting), can be adjusted to 4 kHz If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current rating (SCCR)	≤ 65 kA rms  Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)
Electromagnetic compatibility according to IEC/EN 61800-3	Devices with integrated filter are suitable for Category C2 environments.
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper
Degree of protection according to EN 60529	IP20; must be installed in a control cabinet
Ambient temperature	LO base load power without derating: -20 °C ... +40 °C HO base load power without derating: -20 °C ... +50 °C LO/HO base load power with derating: -20 °C ... +60 °C  Restrictions for special ambient conditions (Page 92) For the maximum permissible ambient temperature, also observe the permissible ambient temperatures for the Control Unit and possibly operator panel (IOP or BOP-2) .
Ambient conditions according to EN 60721-3-3	Protected against damaging chemical substance, according to environmental Class 3C3
Temperature during storage according to EN 60721-3-3	-40 °C ... +70 °C
Cooling air	clean and dry air
Relative humidity	< 95%


Property	Version
Pollution according to EN 61800-5-1	suitable for environments with degree of pollution 2, condensation not permissible
Shocks and vibration according to EN 60721-3-1	<ul style="list-style-type: none"> • Long-term storage in the transport packaging according to Class 1M2 • Transport in the transport packaging according to Class 2M3 • Vibration in operation according to Class 3M2
Installation altitude	without derating: up to 1000 m above sea level with derating: up to 4000 m above sea level
	 Restrictions for special ambient conditions (Page 92)
Approvals	cULus, CE, C-tick, SEMI F47, KCC,WEEE, RoHS, EAC

Dependent on the input voltage and output power 690 V inverters



7.5.2 Specific technical data, 690 V inverters

The fuses listed in the following tables are examples of suitable fuses.

Additional components for branch protection:  Branch protection and short-circuit strength according to UL and IEC

(<https://support.industry.siemens.com/cs/ww/en/view/109479152>)

Table 7- 24 PM240-2, IP20, FSD, 3 AC 500 V ... 690 V

Article No. - without filter	6SL3210-...	...1PH21-4UL0	...1PH22-0UL0	...1PH22-3UL0
Article No. - with filter	6SL3210-...	...1PH21-4AL0	...1PH22 -0AL0	...1PH22 -3AL0
LO base load power		11 kW	15 kW	18.5 kW
LO base load input current		14 A	18 A	22 A
LO base load output current		14 A	19 A	23 A
HO base load power		7.5 kW	11 kW	15 kW
HO base load input current		11 A	14 A	20 A
HO base load output current		11 A	14 A	19 A
Siemens fuse according to IEC/UL		3NE1 815-0 / 25 A	3NE1 815-0 / 25 A	3NE1 803-0 / 35 A
Fuse according to IEC/UL, Class J		20 A	25 A	30 A
Power loss without filter		0.32 kW	0.41 kW	0.48 kW
Power loss with filter		0.32 kW	0.41 kW	0.48 kW
Required cooling air flow		55 l/s	55 l/s	55 l/s
Weight without filter		17 kg	17 kg	17 kg
Weight with filter		18.5 kg	18.5 kg	18.5 kg

Table 7- 25 PM240-2, IP20, FSD, 3 AC 500 V ... 690 V

Article No. - without filter	6SL3210-...	...1PH22-7UL0	...1PH23-5UL0	...1PH24-2UL0
Article No. - with filter	6SL3210-...	...1PH22 -7AL0	...1PH23 -5AL0	...1PH24 -2AL0
LO base load power		22 kW	30 kW	37 kW
LO base load input current		25 A	33 A	40 A
LO base load output current		27A	35 A	42 A
HO base load power		18.5 kW	22 kW	30 kW
HO base load input current		24 A	28 A	36 A
HO base load output current		23 A	27 A	35 A
Siemens fuse according to IEC/UL		3NE1 803-0 / 35 A	3NE1 817-0 / 50 A	3NE1 818-0 / 63 A
Fuse according to IEC/UL, Class J		35 A	45 A	60 A
Power loss without filter		0.56 kW	0.72 kW	0.88kW
Power loss with filter		0.56 kW	0.73kW	0.88 kW
Required cooling air flow		55 l/s	55 l/s	55 l/s
Weight without filter		17 kg	17 kg	17 kg
Weight with filter		18.5 kg	18.5 kg	18.5 kg

7.5 Technical data, 690 V inverters

Table 7- 26 PM240-2, IP20, FSE, 3 AC 500 V ... 690 V

Article No. - without filter	6SL3210-...	...1PH25-2UL0	...1PH26-2UL0
Article No. - with filter	6SL3210-...	...1PH25-2AL0	...1PH26 -2AL0
LO base load power		45 kW	55 kW
LO base load input current		50 A	59 A
LO base load output current		52 A	62A
HO base load power		37 kW	45 kW
HO base load input current		44 A	54 A
HO base load output current		42 A	52 A
Siemens fuse according to IEC/UL		3NA1 820-0 / 80A	3NE1 820-0 / 80A
Fuse according to IEC/UL, Class J		80 A	80 A
Power loss without filter		1.00 kW	1.21 kW
Power loss with filter		1.00 kW	1.22 kW
Required cooling air flow		83 l/s	83 l/s
Weight without filter		26 kg	26 kg
Weight with filter		28 kg	28 kg

Table 7- 27 PM240-2, IP20, FSF, 3 AC 500 V ... 690 V

Article No. - without filter	6SL3210-...	...1PH28-0UL0	...1PH31-0UL0	...1PH31-2UL0
Article No. - with filter	6SL3210-...	...1PH28-0AL0	...1PH31-0AL0	...1PH31-2AL0
LO base load power		75 kW	90 kW	110 kW
LO base load input current		78 A	97 A	111 A
LO base load output current		80 A	100 A	115 A
HO base load power		55 kW	75 kW	90 kW
HO base load input current		66 A	85 A	106 A
HO base load output current		62 A	80 A	100 A
Siemens fuse according to IEC/UL		3NE1 021-0 / 100 A	3NE1 022-0 / 125 A	3NE1 224-0 / 160 A
Fuse according to IEC/UL, Class J		100 A	125 A	150 A
Power loss without filter		1.34 kW	1.71 kW	2 kW
Power loss with filter		1.35 kW	1.72 kW	2.02 kW
Required cooling air flow		153 l/s	153 l/s	153 l/s
Weight without filter		60 kg	60 kg	60 kg
Weight with filter		64 kg	64 kg	64 kg

Table 7- 28 PM240-2, IP20, FSF, 3 AC 500 V ... 690 V

Article No. - without filter	6SL3210-...	...1PH31-4UL0
Article No. - with filter	6SL3210-...	...1PH31 4AL0
LO base load power		132 kW
LO base load input current		137 A
LO base load output current		142 A
HO base load power		110 kW
HO base load input current		122 A
HO base load output current		115 A
Siemens fuse according to IEC/UL	3NE1 225-0 / 200 A	
Fuse according to IEC/UL, Class J	200 A	
Power loss without filter		2.56 kW
Power loss with filter		2.59 kW
Required cooling air flow		153 l/s
Weight without filter		60 kg
Weight with filter		64 kg

7.5.3 Current derating depending on the pulse frequency, 690 V inverters

Article number	LO base load output current for a pulse frequency of ... [A]	
	2 kHz	4 kHz
6SL3210-1PH21-4□L0	14	8.4
6SL3210-1PH22-0□L0	19	11.4
6SL3210-1PH22-3□L0	23	13.8
6SL3210-1PH22-7□L0	27	16.2
6SL3210-1PH23-5□L0	35	21
6SL3210-1PH24-2□L0	42	25.2
6SL3210-1PH25-2□L0	52	31.2
6SL3210-1PH26-2□L0	62	37.2
6SL3210-1PH28-0UL0	80	48
6SL3210-1PH31-0□L0	100	60
6SL3210-1PH31-2□L0	115	69
6SL3210-1PH31-4□L0	142	85.2

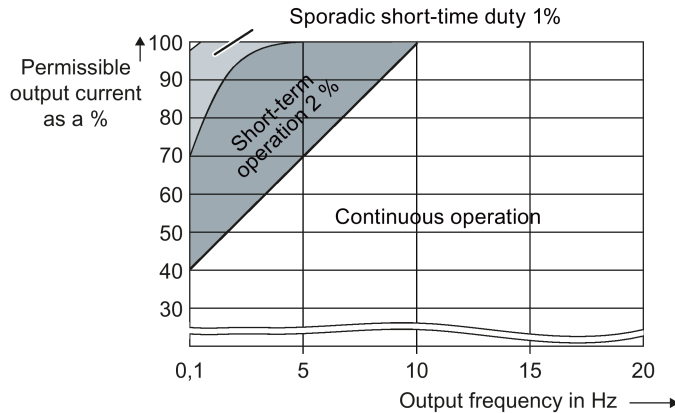
The permissible motor cable length depends on the particular cable type and the pulse frequency that has been selected

7.6 Restrictions for special ambient conditions

Maximum current at low speeds

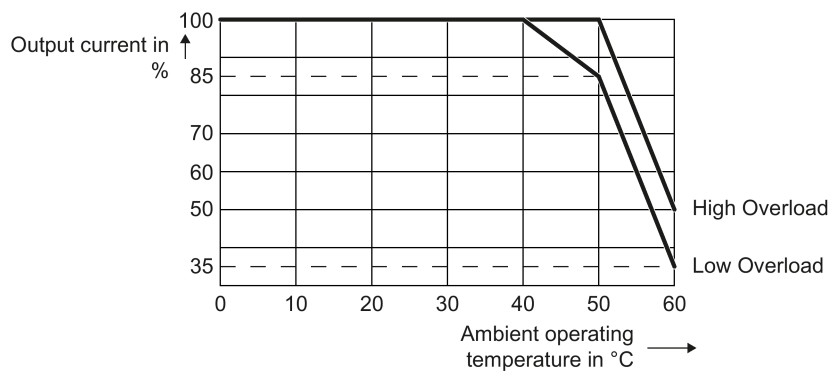
At low speeds, the inverter can only briefly supply the base load output current. It is especially important to note that 0 Hz operation is not continuously permissible.

The operating conditions shown in the following diagram are possible without having a negative impact on the inverter service life.



- Continuous operation: Operating state that is permissible for the complete operating time.
- Short-time duty: Operating state that is permissible for less than 2 % of the operating time.
- Sporadic short-time duty: Operating state that is permissible for less than 1 % of the operating time.

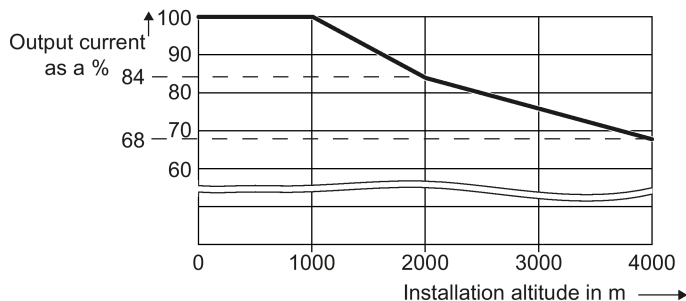
Current de-rating depending on the ambient operating temperature



The Control Unit and operator panel can restrict the maximum permissible operating ambient temperature of the Power Module.

Current derating depending on the installation altitude

Above 1000 m above sea level you must reduce the inverter output current as a result of the lower cooling capability of the air.



Permissible line supplies depending on the installation altitude

- Installation altitude up to 2000 m above sea level
 - Connection to every supply system permitted for the inverter.
- Installation altitudes between 2000 m and 4000 m above sea level
 - Connection to a TN system with grounded neutral point.
 - TN systems with grounded line conductor are not permitted.
 - The TN line system with grounded neutral point can also be supplied using an isolation transformer.
 - The phase-to-phase voltage does not have to be reduced.

Note

TN line supply for 690 V Power Modules for installation altitudes extending from 2000 m to 4000 m

For 690 V Power Modules, the TN line system must be established with grounded neutral point through an isolating transformer.

7.7 Electromagnetic compatibility of the inverter

The electromagnetic compatibility refers to both the immunity and the emitted interference of a device.

The following disturbance variables must be taken into consideration when evaluating the electromagnetic compatibility:

- Conducted low-frequency disturbance variables (harmonics)
- Conducted high-frequency disturbance variables
- Field-based, low-frequency disturbance variables
- Field-based, high-frequency disturbance variables

The permitted limit values are defined in the EMC product standard EN 61800-3 in EMC categories C1 to C4.

Below you will find some key definitions relating to this.

Classification of EMC behavior

The EMC environment and the EMC Categories are defined in the EMC product standard EN 61800-3 as follows:

Environments:

First environment (public systems)

An environment that includes domestic premises and establishments that are connected directly to a public low-voltage line supply without the use of an intermediate transformer.

Example: Houses, apartments, commercial premises, or offices in residential buildings.

Second environment (industrial systems)

An environment that includes all other establishments which are not connected directly to a public low-voltage line supply.

Example: Industrial areas and technical areas of buildings that are supplied by an assigned transformer.

Categories

Category C4

Drive systems with a rated voltage $\geq 1,000$ V, with an LO output current ≥ 400 A, or for use in complex systems in the second environment

Drive systems which correspond to category C4 may only be installed in the second environment.

Category C3

Drive systems with a rated voltage < 1,000 V, which are intended for use in the second environment and not for use in the first environment.

Drive systems which correspond to category C3 may only be installed in the second environment.

Category C2

Drive systems with a rated voltage < 1,000 V, which are neither plug-in devices nor moveable devices and which, when used in the first environment, are only intended to be installed and commissioned by an expert.

Drive systems which correspond to category C2 may only be used in the first environment if they are installed by an expert, with limit values for electromagnetic compatibility observed.

Category C1

Drive systems with a rated voltage < 1000 V, which are intended for use in the first environment.

Drive systems which correspond to category C1 can be installed in the first environment without restrictions.

Note

Expert

An expert is a person or organization with the necessary experience for installing and/or commissioning drive systems (Power Drive Systems - PDS), including the associated EMC aspects.

7.7.1 Assigning the inverter to EMC categories

The inverters have been tested in accordance with the EMC product standard EN 61800-3.



The declaration of conformity is available at Hotspot-Text (<http://support.automation.siemens.com/WW/view/en/58275445>)

Requirements for electromagnetic compatibility

To comply with the requirements of EN 61800-3, all drives must be installed in accordance with the manufacturer's instructions and EMC directives.




The EMC regulations are available at Hotspot-Text (<http://support.automation.siemens.com/WW/view/en/58275445>)

The installation must be performed by an expert who has the necessary experience for installing and/or commissioning power drives, including their EMC aspects.

Second environment - category C4

The unfiltered inverters correspond to category C4.

EMC measures in the second environment, category C4, are carried out on the basis of an EMC plan on the system level.

Further information:  EMC-compliant installation (Page 50).

Second environment - category C3

Immunity

With respect to their immunity, the inverters are suitable for the second environment, Category C3.

Interference emission for filtered inverters

Inverters with integrated filter are suitable for use in the second environment, Category C3.

Interference emission for unfiltered inverters

If you are using unfiltered inverters in an industrial plant, you must either use an external filter for the converter or install corresponding filters on the system level (conducted high-frequency disturbance variables).

When installed professionally in accordance with EMC guidelines, the converters fulfill the requirements of the standard in relation to category C3 (field-based high-frequency disturbance variables).

Second environment - category C2

Inverters with integrated filter are suitable for use in the second environment, Category C2.

First environment - category C2

Frame sizes FSA ... FSC

Inverters with integrated filter are suitable for use in the first environment, Category C2 if you additionally install high-frequency filters or 4% reactors on the line side.

Frame sizes FSD ... FSF

Inverters with integrated filter are suitable for use in the first environment, Category C2.

Note

Requirements placed on the short-circuit power (fault level) of the line supply

The inverters are compliant with IEC 61000-3-12 under the assumption that the short-circuit power (fault level) R_{scc} at the connection point of the customers system with the public grid is greater than or equal to 120.

The installation company or company operating the device is responsible for ensuring that this device is only connected at a connection point with a short-circuit power (fault level) R_{scc} that is greater than or equal to 120. If necessary, the utility company must be contacted and the situation discussed.

7.7.2 Harmonics

Current as a % for	Harmonic number							
	5th	7th	11th	13th	17th	19th	23rd	25th
FSA ... FSC, 200 V, 400 V ¹⁾	54	39	11	5.5	5	3	2	2
FSD ... FSF, 200 V ²⁾	28	14	8	6	5	4	3	3
FSD ... FSF, 400 V ²⁾	37	21	7	5	4	3	3	2
FSD ... FSF, 690 V ²⁾	34	18	8	5	4	3	3	2

¹⁾ Typical harmonic currents as a % referred to the LO input current for U_k 1 %

²⁾ Typical harmonic currents as a %

7.7.3 EMC limit values in South Korea

Is applicable for filtered 400 V inverters, frame sizes FSD ... FSF.

All other inverters do not comply with the limit values.

이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

For sellers or users, please keep in mind that this device is an A-grade electromagnetic wave device. This device is intended to be used in areas other than home.

The EMC limit values to be complied with for South Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3, Category C2 or limit value class A, Group 1 according to EN55011. By applying suitable supplementary measures, the limit values according to Category C2 or according to limit value class A, Group 1 are maintained. Further, additional measures may be required, for instance, using an additional radio interference suppression filter (EMC filter). The measures for EMC-compliant design of the system are described in detail in this manual respectively in the Installation Guideline EMC.

Please note that the final statement on compliance with the standard is given by the respective label attached to the individual unit.



You can find the Configuration Manual "EMC installation guidelines" under (<http://support.automation.siemens.com/WW/view/en/60612658>)

Spare parts and accessories

8.1 Spare parts

Frame sizes FSA ... FSC

	Article No.		
	FSA	FSB	FSC
Accessory kit IP20*)	A5E33860501A	A5E33879111A	A5E33879131A
Accessory kit PT*)	A5E03396337	A5E03395273	A5E03343234

*) Included in the scope of delivery of the inverter

Spare parts, frame sizes FSD ... FSF

	Article No.		
	FSD	FSE	FSF
Set of small components	6SL3200-0SK08-0AA0	6SL3200-0SK08-0AA0	6SL3200-0SK08-0AA0
Mechanical kit	6SL3200-0SM13-0AA0	6SL3200-0SM14-0AA0	6SL3200-0SM15-0AA0
Fan kit	6SL3200-0SF15-0AA0	6SL3200-0SF16-0AA0	6SL3200-0SF17-0AA0
Accessory kit *)	6SL3262-1AD01-0DA0	6SL3262-1AE01-0DA0	6SL3262-1AF01-0DA0

*) Included in the scope of delivery of the inverter

8.2 Optional accessories

Which components are available?

- Mounting frames for PT Power Modules - only frame sizes FSA ... FSC
- Line reactor - only frame sizes FSA ... FSC
- Line filter
- Braking resistor
- Brake Relay and Safe Brake Relay
- Output reactors

Connection components

Connection overview for the electrical components  Connection overview (Page 42).

8.2.1 Mounting frames for PT power modules

Article numbers

- FSA: 6SL3260-6AA00-0DA0
- FSB: 6SL3260-6AB00-0DA0
- FSC: 6SL3260-6AC00-0DA0

The supplementary package contains all the necessary nuts and seals.

The tightening torque to attach the mounting frame and inverter is 3.5 Nm for all mounting frames.

NOTICE
Degree of protection is only guaranteed for Siemens mounting frames
The IP55 degree of protection for the PT devices can only be guaranteed, if the applicable Siemens mounting frame is used and this is correctly installed. The specified tightening torque for the fixing screws (3.5 Nm) is also only valid for Siemens mounting frames.

Dimension drawings

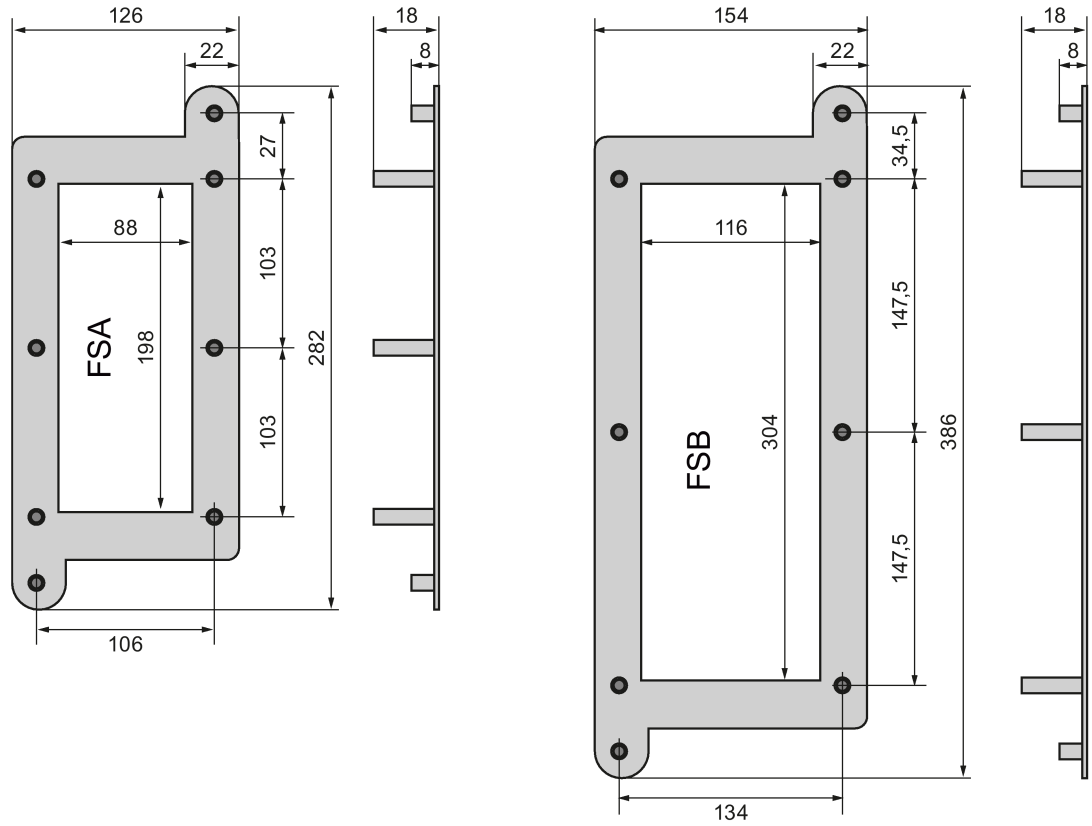


Figure 8-1 Mounting frames_FSA - FSB

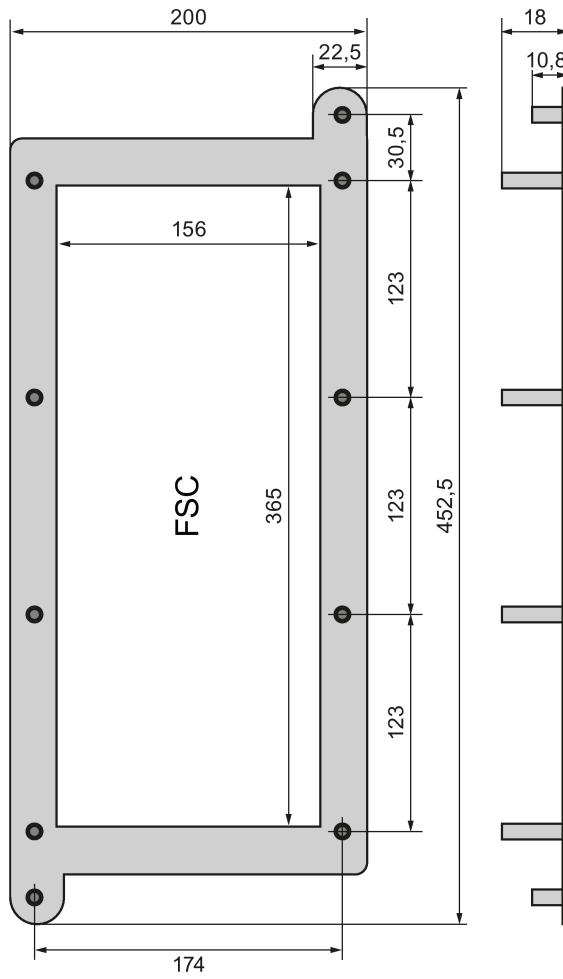


Figure 8-2 Mounting frames_FSC

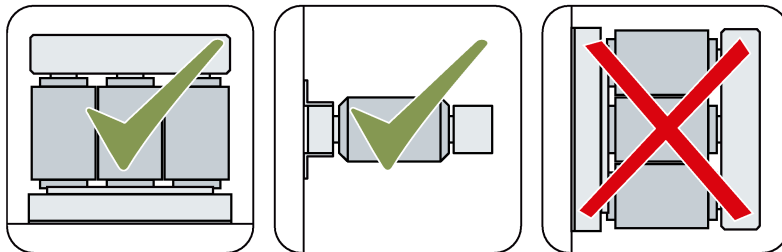
8.2.2 Line reactor

A line reactor protects the inverter when connected to dirty line supplies. A line reactor supports the overvoltage protection, smooths the harmonics in the line supply and buffers commutation dips.

If the line impedance is below 1%, you must install a line reactor to achieve the optimum service life of your inverter.

8.2.2.1 Line reactors for PM240-2, 400 V

Mounting position



Clearances to other devices

For a line reactor, a minimum clearance to other devices must be maintained on all sides.

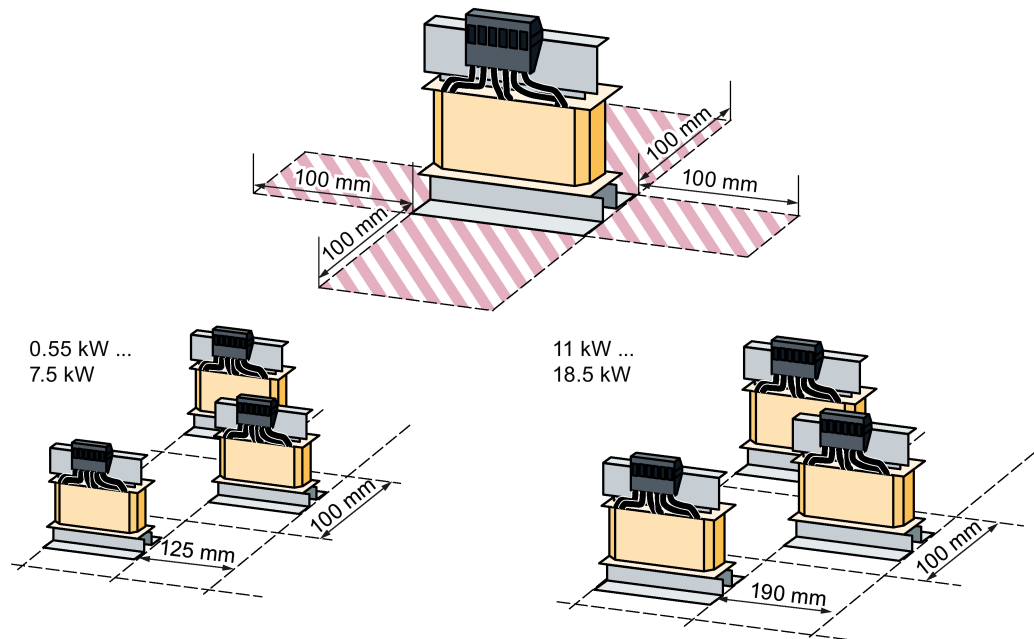
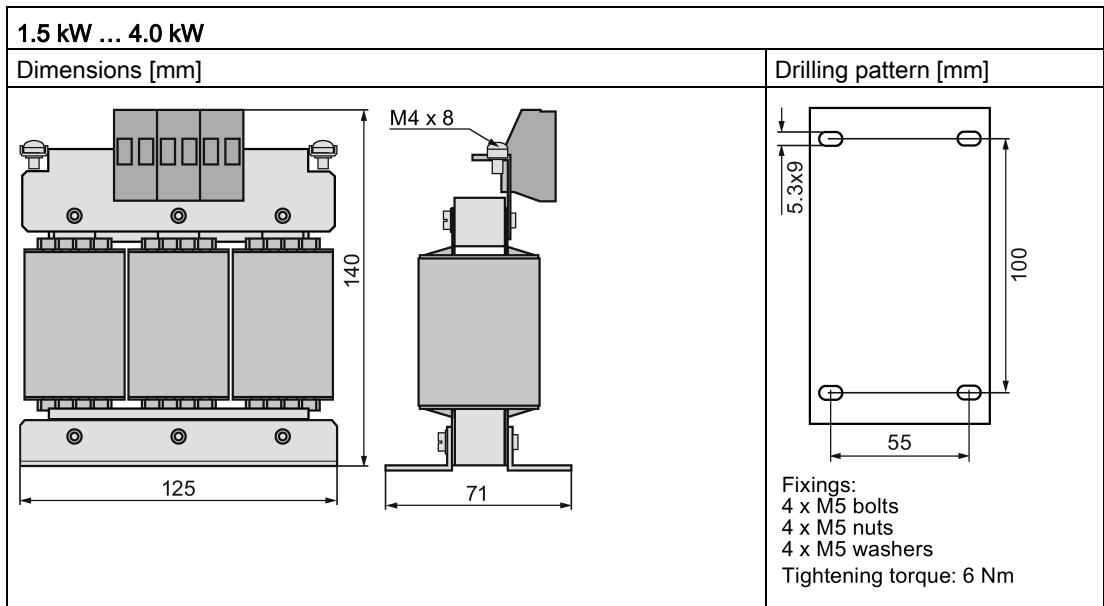
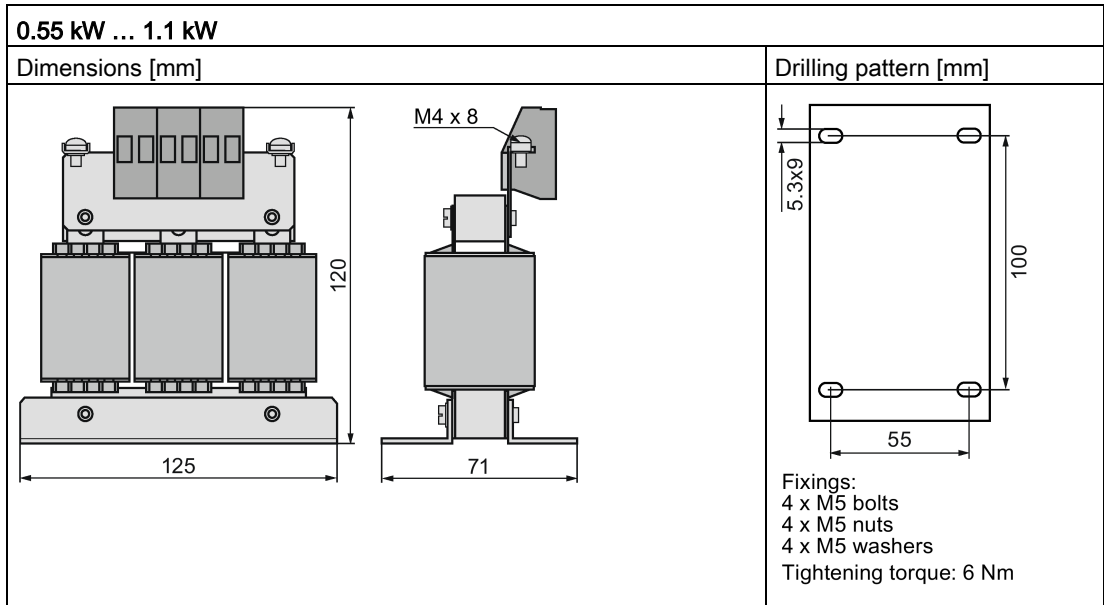


Figure 8-3 Clearances between the line reactors and other devices, examples for space-saving installation

Dimensions and drilling patterns



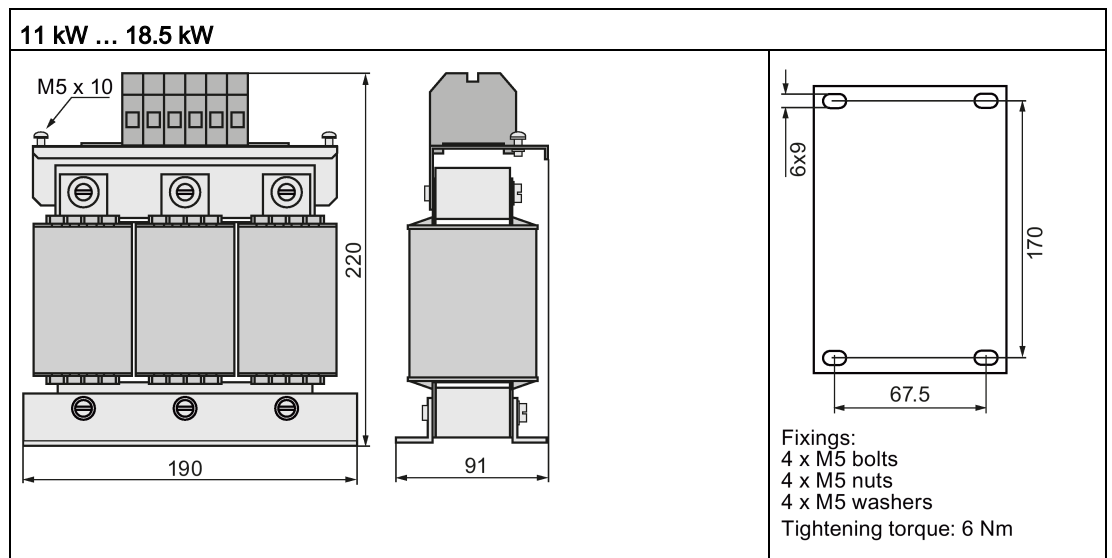
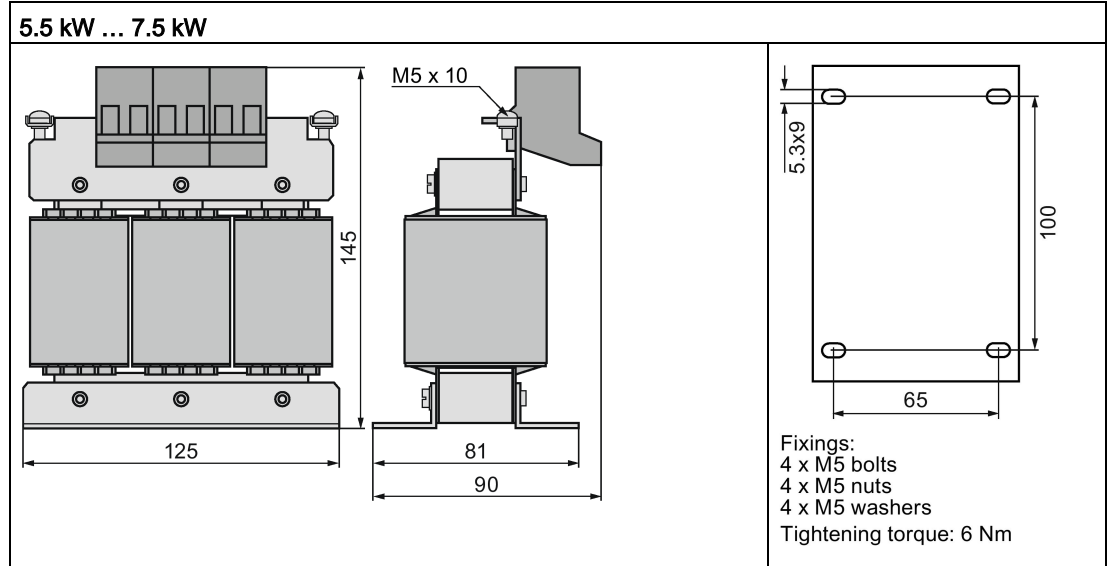


Table 8- 1 Technical data of the line reactors

Article number	6SL3203-0CE13-2AA0	6SL3203-0CE21-0AA0	6SL3203-0CE21-8AA0	6SL3203-0CE23-8AA0
Inductance	2.5 mH	1 mH	0.5 mH	0.3mH
Line/load connection	2.5 mm ² / 14 AWG 0.8 Nm / 7 lbf in	2.5 mm ² / 14 AWG 0.8 Nm / 7 lbf in	6 mm ² / 10 AWG 1.8 Nm / 15.9 lbf in	16 mm ² / 6 AWG 4.0 Nm / 35.4 lbf in
PE connection	M4 (3 Nm / 26.5 lbf in)	M4 (3 Nm / 26.5 lbf in)	M5 (5 Nm / 44.3 lbf in)	M5 (5 Nm / 44.3 lbf in)
Degree of protection	IP20	IP20	IP20	IP20
Weight	1.1 kg	2.1 kg	2.95 kg	7.80 kg

Table 8- 2 Assignment table

Line reactors	400 V Power Modules	200 V Power Modules
6SL3203-0CE13-2AA0	6SL3210-1PE11-8□L1, 6SL3210-1PE12-3□L1 6SL3210-1PE13-2□L1	6SL3210-1PB13-0□L0, 6SL3210-1PB13-8□L0
6SL3203-0CE21-0AA0	6SL3210-1PE14-3□L1, 6SL321□-1PE16-1□L1 6SL321□-1PE18-0□L1	6SL3210-1PB15-5□L0, 6SL3210-1PB17-4□L0 6SL321□-1PB21-0□L0
6SL3203-0CE21-8AA0	6SL3210-1PE21-1□L0, 6SL3210-1PE21-4□L0 6SL321□-1PE21-8□L0	6SL3210-1PB21-4□L0 6SL321□-1PB21-8□L0
6SL3203-0CE23-8AA0	6SL3210-1PE22-7□L0, 6SL321□-1PE23-3□L0	6SL321□-1PC22-2□L0 6SL3210-1PC22-8□L0

8.2.2.2 Line reactors for PM240-2, 200 V

We recommend the following or similar products as line reactors for inverters with input voltages 1 AC 200 V:

- FSA:
NKE 10 / 2.93 (Block company)
- FSB
NKE 25 / 1.17 (Block company)
- FSC
NKE 35 / 1.46 (Block company)

The technical properties and statements made by the manufacturer apply.

8.2.3 Line filter

Dimensions for mounting the line filter

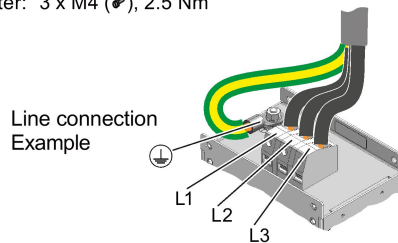
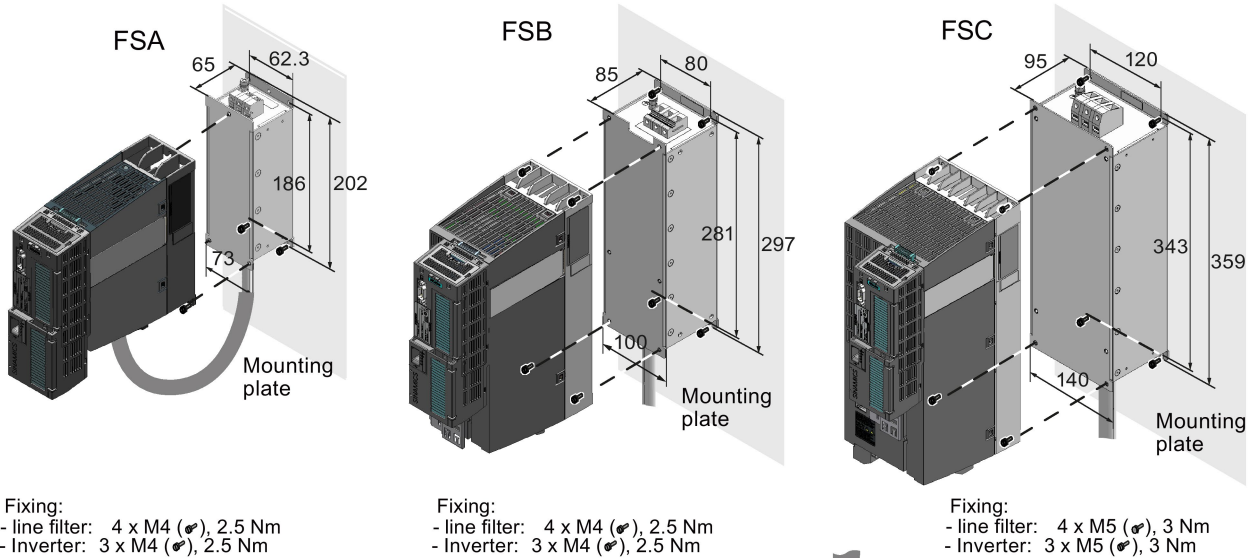


Table 8-3 Technical data of the line filter (Class B)

Article number	6SL3203-0BE17-7BA0	6SL3203-0BE21-8BA0	6SL3203-0BE23-8BA0
Power loss	13 W	22 W	49.4 W
Line/load connection	2.5 mm ² / 14 AWG 0.8 Nm / 7 lbf in	6 mm ² / 10 AWG 1.8 Nm / 15.9 lbf in	16 mm ² / 6 AWG 4.0 Nm / 35.4 lbf in
PE connection	2.5 mm ² / 14 AWG 2 Nm / 17.7 lbf in	2.5 mm ² / 14 AWG 2 Nm / 17.7 lbf in	16 mm ² / 6 AWG 3 Nm / 26.5 lbf in
Degree of protection	IP20	IP20	IP20
Weight	1.75 kg	4.0 kg	7.3 kg

Table 8-4 Assignment table


Line filter (Class B)	400 V Power Modules		
6SL3203-0BE17-7BA0	6SL3210-1PE11-8UL1 6SL3210-1PE14-3UL1	6SL3210-1PE12-3UL1 6SL3210-1PE16-1UL1	6SL3210-1PE13-2UL1 6SL321□-1PE18-0UL1
6SL3203-0BE21-8BA0	6SL3210-1PE21-1UL0	6SL3210-1PE21-4UL0	6SL321□-1PE21-8UL0
6SL3203-0BE23-8BA0	6SL3210-1PE22-7UL0	6SL321□-1PE23-3UL0	

□ Stands for 1 or 2: 1: Chassis device 2: PT device

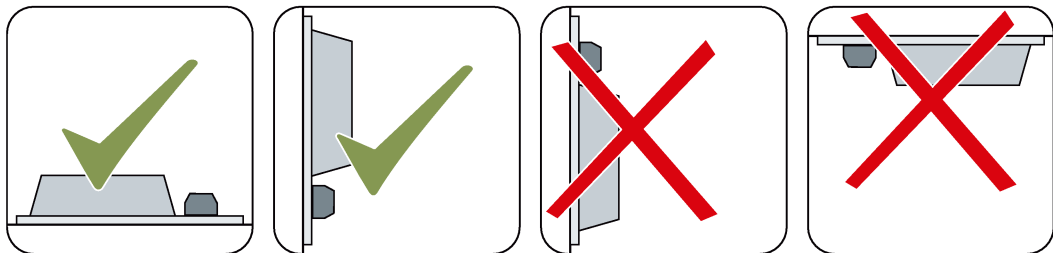
8.2.4 Braking resistor

The braking resistor enables loads with a large moment of inertia to be braked quickly. During braking of the motor and the load, excess energy is fed back to the converter. This causes the voltage to rise in the DC link. The converter transfers the excess energy to the externally mounted braking resistor.



 WARNING
((Danger to life due to fire spreading because of an unsuitable or improperly installed braking resistor))
Using an unsuitable or improperly installed braking resistor can cause fires and smoke to develop. Fire and smoke development can cause severe personal injury or material damage.
<ul style="list-style-type: none">• Only use braking resistors that are approved for the inverter.• Install the braking resistor in accordance with regulations.• Monitor the temperature of the braking resistor.

Mounting position



Mounting instructions

Mount the resistor on a heat resistant surface with a high thermal conductivity.

Do not cover the ventilation openings of the braking resistor.

You can mount the braking resistor either outside or inside the switchgear room. When mounted outside, the cooling air requirement for the switchgear room is lower.

Clearances to other devices

The following data are applicable for devices, frame sizes FSA ... FSC.

The clearances for braking resistors for devices, frame sizes FSD ... FSF are specified in the documentation, which is supplied with the braking resistor.

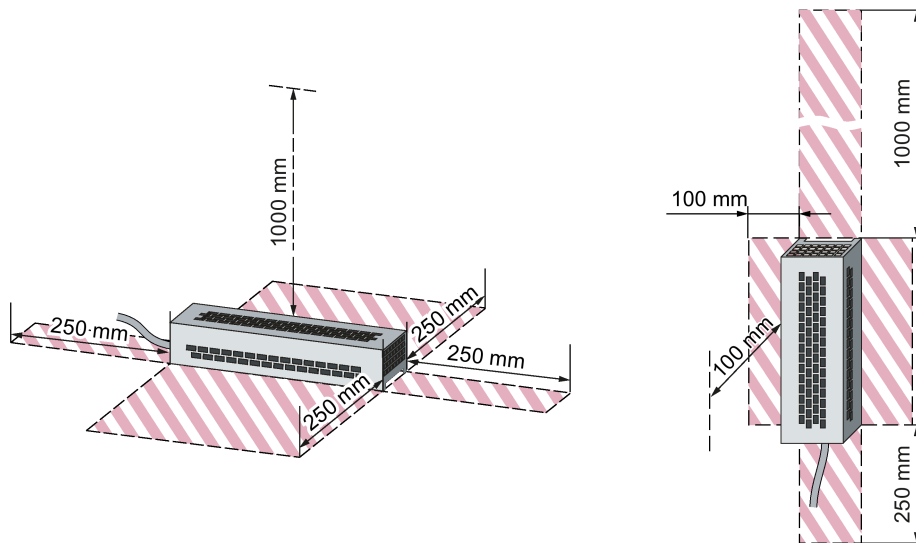


Figure 8-4 Minimum clearances for the braking resistor when mounting on a flat surface and for wall/panel mounting

Keep shaded areas free of any devices and components.

Dimensions and drilling patterns

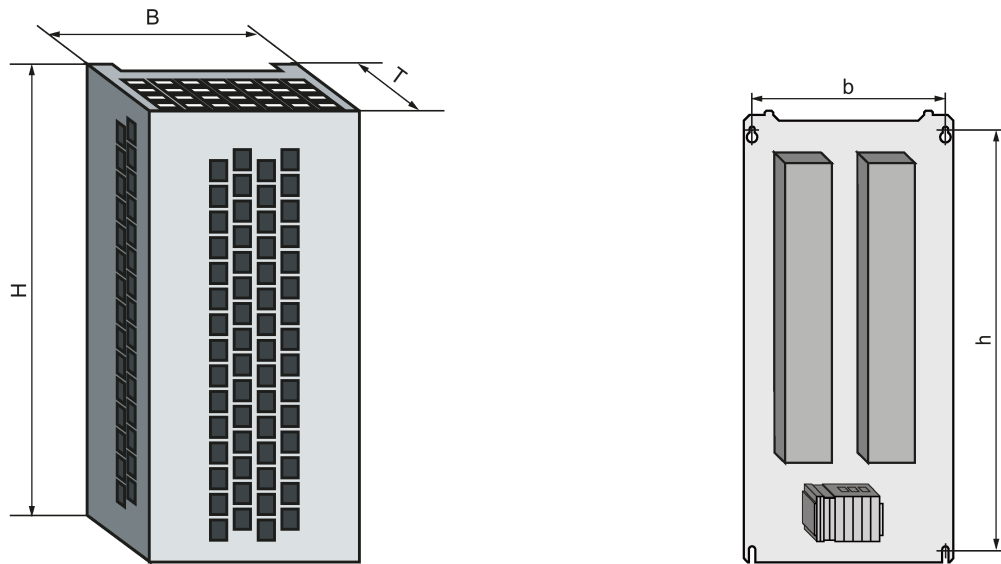


Figure 8-5 Braking resistor

Table 8- 5 Dimensions and weights

Article No.	Overall dimensions (mm)			Drilling dimensions (mm)			Weight (kg)	Inverter frame size
	W	H	D	b	h	Mounting		
for 200 V inverters								
JJY:023146720008	105	295	100	72	266	M4 / 3 Nm	1.5	FSA
JJY:023151720007	105	345	100	72	316	M4 / 3 Nm	1.8	FSB
JJY:02 3163720018	175	345	100	142	316	M4 / 3 Nm	2.7	FSC
JJY:023433720001	250	490	140	217	460	M5 / 6 Nm	6.2	FSC
JJY:023422620002	220	470	180	187	430	M5 / 6 Nm	7	FSD
JJY:023423320001	220	560	180	187	500	M5 / 6 Nm	8.5	FSE
JJY:023434020003	350	630	180	317	570	M5 / 6 Nm	13.5	FSF
for 400 V inverters								
6SL3201-0BE14-3AA0	105	295	100	72	266	M4 / 3 Nm	1.5	FSA
6SL3201-0BE21-0AA0	105	345	100	72	316	M4 / 3 Nm	1.8	FSA
6SL3201-0BE21-8AA0	175	345	100	142	316	M4 / 3 Nm	2.7	FSB
6SL3201-0BE23-8AA0	250	490	140	217	460	M5 / 6 Nm	6.2	FSC
JJY:023422620001	220	470	180	187	430	M5 / 6 Nm	7	FSD
JJY:023424020001	220	610	180	187	570	M5 / 6 Nm	9.5	FSD
JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	FSE
JJY:023454020001 ^{*)}								FSF
• JJY:023422620001	220	470	180	187	430	M5 / 6 Nm	7	(FSD)
• JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
JJY:023464020001 ^{*)}								FSF
• JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
• JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
for 690 V inverters								
JJY:023424020002	220	610	180	187	570	M5 / 6 Nm	9.5	FSD
JJY:023434020002	350	630	180	317	570	M5 / 6 Nm	13.5	FSE
JJY:023464020002 ^{*)}								FSF
• JJY:023434020002	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
• JJY:023434020002	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)

Use the screws, nuts and washers when fixing the braking resistors

*) This braking resistor comprises two components, which must be connected in parallel on the plant/system side

8.2.4.1 Connect the temperature contact of the braking resistor

Monitoring the temperature of the braking resistor

Procedure

- ➔ 1 Proceed as follows to monitor the braking resistor temperature:
- 2 1. Connect the temperature monitoring system of the braking resistor (terminals T1 and T2 on the braking resistor) to a free digital input at the Control Unit of the inverter.

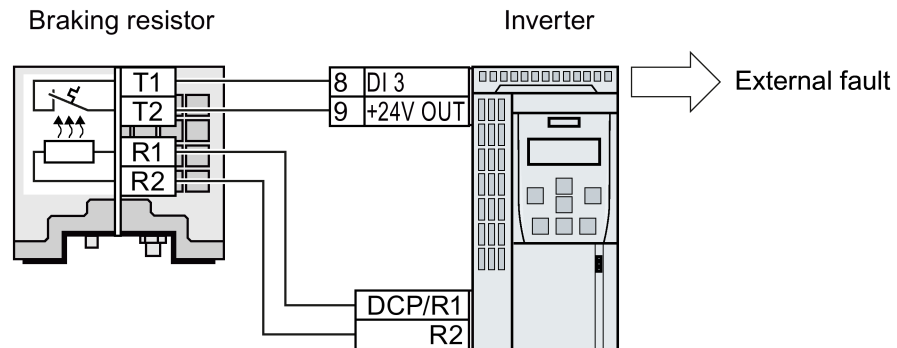


Figure 8-6 Example: Temperature monitoring of the braking resistor via digital input DI 3 on the Control Unit

2. When commissioning the drive, define the function of the digital input used as external fault, using p2106.

As an example with temperature monitoring via digital input DI 3: p2106 = 722.3.

- You have ensured that the temperature is monitored.

For the inverters, use the following or comparable braking resistors. The technical properties and statements made by the manufacturer apply.

Note

Braking resistors FSD ... FSF

Only use braking resistors that are UL approved, and have successfully passed the "Abnormal Operation Test" according to UL 508.

Braking resistors for PM240-2, 200 V

Table 8- 6 Technical data

Article No.	Re- sistance	Maximum power, P _{max}	Connection	Degree of protection	Power Module		
		Rated power P _{db}		Weight	Article Nos.	Frame size	
JJY:023146720008	200 Ω	0.75 kW	Connecting cable integrated in the braking resistor	IP20	6SL3210-1PB13-0□L0	FSA	
		37.5 W		1.5	6SL321□-1PB13-8□L0		
JJY:023151720007	68 Ω	2.2 kW		IP20	6SL3210-1PB15-5□L0	FSB	
		110 W		1.8	6SL3210-1PB17-4□L0 6SL321□-1PB21-0□L0		
JJY:02 3163720018	37 Ω	4 kW		IP20	6SL3210-1PB21-4□L0		FSC
		200 W		2.7	6SL321□-1PB21-8□L0		
JJY:023433720001	20 Ω	7.5 kW		IP20	6SL3210-1PC22-2□L0	FSC	
		375 W		6.2	6SL3210-1PC22-8□L0		
JJY:023422620002	7.5 Ω	18.5 kW		10 mm ² / 0.5 Nm 8 AWG / 4.5 lbf in	IP21	6SL3210-1PC24-2□L0	FSD
		930 W			7.0 kg	6SL3210-1PC25-4□L0 6SL3210-1PC26-8□L0	
JJY:023423320001	4.5 Ω	30 kW	16 mm ² / 1.2 Nm 6 AWG / 10.6 lbf in	IP21	6SL3210-1PC28-8□L0	FSE	
		1500 W		8.5 kg	6SL3210-1PC31-1□L0		
JJY:023434020003	2.5 Ω	55 kW	16 mm ² / 1.2 Nm 6 AWG / 10.6 lbf in	IP21	6SL3210-1PC31-3□L0	FSF	
		2750 W		13.5 kg	6SL3210-1PC31-6□L0 6SL3210-1PC31-8□L0		

Braking resistors for PM240-2, 400 V

Table 8- 7 Technical data

Article number	Re- sistance	Maximum power, P _{max}	Connection R1 / R2	Degree of protection	Power Module	
		Rated power P _{db}		Weight	Article Nos.	Frame size
6SL3201-0BE14-3AA0	370 Ω	1.5 kW	2.5 mm ² / 0.5 Nm 14 AWG / 4.5 lbf in	IP20	6SL3210-1PE11-8□L1 6SL3210-1PE12-3□L1 6SL3210-1PE13-2□L1 6SL3210-1PE14-3□L1	FSA
		75 W		1.5 kg		
6SL3201-0BE21-0AA0	140 Ω	4 kW	2.5 mm ² / 0.5 Nm 14 AWG / 4.5 lbf in	IP20	6SL321□-1PE16-1□L1 6SL321□-1PE18-0□L1	FSA
		200 W		1.8 kg		
6SL3201-0BE21-8AA0	75 Ω	7.5 kW	4 mm ² / 0.7 Nm 10 AWG / 6.2 lbf in	IP20	6SL3210-1PE21-1□L0 6SL3210-1PE21-4□L0 6SL321□-1PE21-8□L0	FSB
		375 W		2.7 kg		
6SL3201-0BE23-8AA0	30 Ω	18.5 kW	4 mm ² / 0.7 Nm 10 AWG / 6.2 lbf in	IP20	6SL3210-1PE22-7□L0 6SL321□-1PE23-3□L0	FSC
		925 W		6.2 kg		
JJY:023422620001	25 Ω	22 kW	10 mm ² / 0.8 Nm 8 AWG / 7.1 lbf in	IP21	6SL3210-1PE23-8□L0 6SL3210-1PE24-5□L0	FSD
		1100 W		7.0 kg		
JJY:023424020001	15 Ω	37 kW	10 mm ² / 0.8 Nm 8 AWG / 7.1 lbf in	IP21	6SL3210-1PE26-0□L0 6SL3210-1PE27-5□L0	FSD
		1850 W		9.5 kg		
JJY:023434020001	10 Ω	55 kW	16 mm ² / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PE28-8□L0 6SL3210-1PE31-1□L0	FSE
		2750 W		13.5 kg		
JJY:023454020001 (JJY:023422620001 JJY:023434020001)	7.1 Ω	77 kW	10 mm ² / 0.8 Nm 8 AWG / 7.1 lbf in 16 mm ² / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PE31-5□L0 6SL3210-1PE31-8□L0	FSF
		3850 W		20.5 kg		
JJY:023464020001 (JJY:023434020001 JJY:023434020001)	5 Ω	110 kW	16 mm ² / 1.2 Nm 6 AWG / 4.5 lbf in 16 mm ² / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PE32-1□L0 6SL3210-1PE32-5□L0	FSF
		5500 W		27 kg		

Braking resistors for PM240-2, 690 V

Table 8- 8 Technical data

Article number	Re-sistance	Maximum power, P_{max}	Connection R1 / R2	Degree of protection	Power Module	
		Rated power P_{db}		Weight	Article Nos.	Frame size
JJY:023424020002	31 Ω	37 kW	10 mm ² / 0.8 Nm 8 AWG / 7.1 lbf in	IP21	6SL3210-1PH21-4□L0 6SL3210-1PH22-0□L0 6SL3210-1PH22-3□L0 6SL3210-1PH22-7□L0 6SL3210-1PH23-5□L0 6SL3210-1PH24-2□L0	FSD
		1850 W		9.5 kg		
JJY:023434020002	21 Ω	55 kW	16 mm ² / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PH25-2□L0 6SL3210-1PH26-2□L0	FSE
		2750 W		13.5 kg		
JJY:023464020002 (JJY:023434020002 JJY:023434020002)	10.5 Ω	110 kW	16 mm ² / 1.2 Nm 6 AWG / 10.6 lbf in 16 mm ² / 1.2 Nm 6 AWG / 10.6 lbf in	IP21	6SL3210-1PH28-0□L0 6SL3210-1PH31-0□L0 6SL3210-1PH31-2□L0 6SL3210-1PH31-4□L0	FSF
		5500 W		27 kg		

Load cycles for the braking resistors

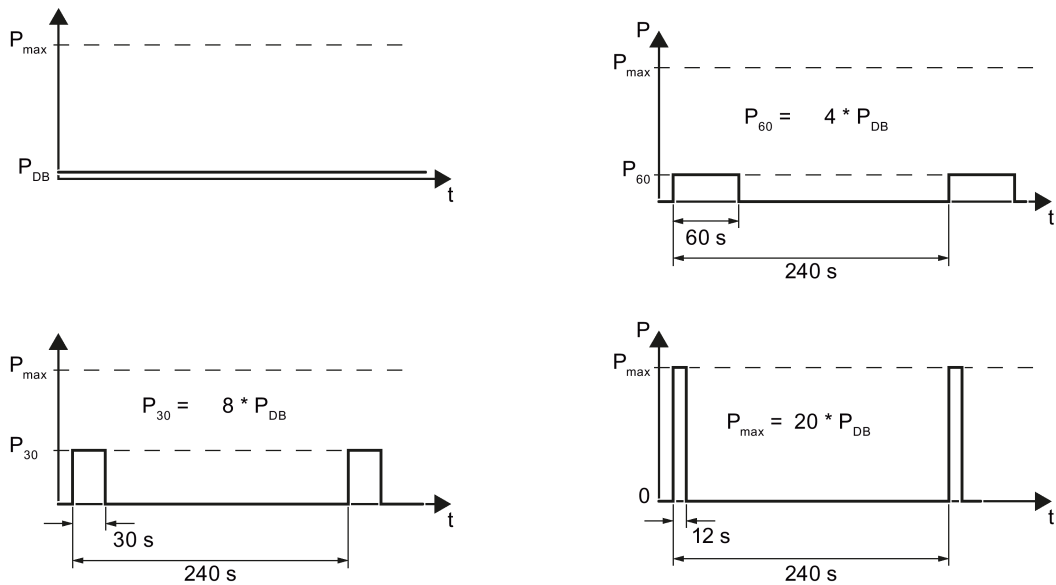


Figure 8-7 Pulse power, rated power and duty cycle examples for the braking resistor

8.2.5 Connecting a motor holding brake

The inverter uses the Brake Relay to control the motor holding brake. Two types of Brake Relay exist:

- The Brake Relay controls the motor holding brake
- The Safe Brake Relay controls a 24 V motor holding brake and monitors the brake control for short-circuit or cable breakage.

Note

Brake Relay and Safe Brake Relay

The Brake Relay and the Safe Brake Relay do not differ from each other in the installation and the connection to the inverter.

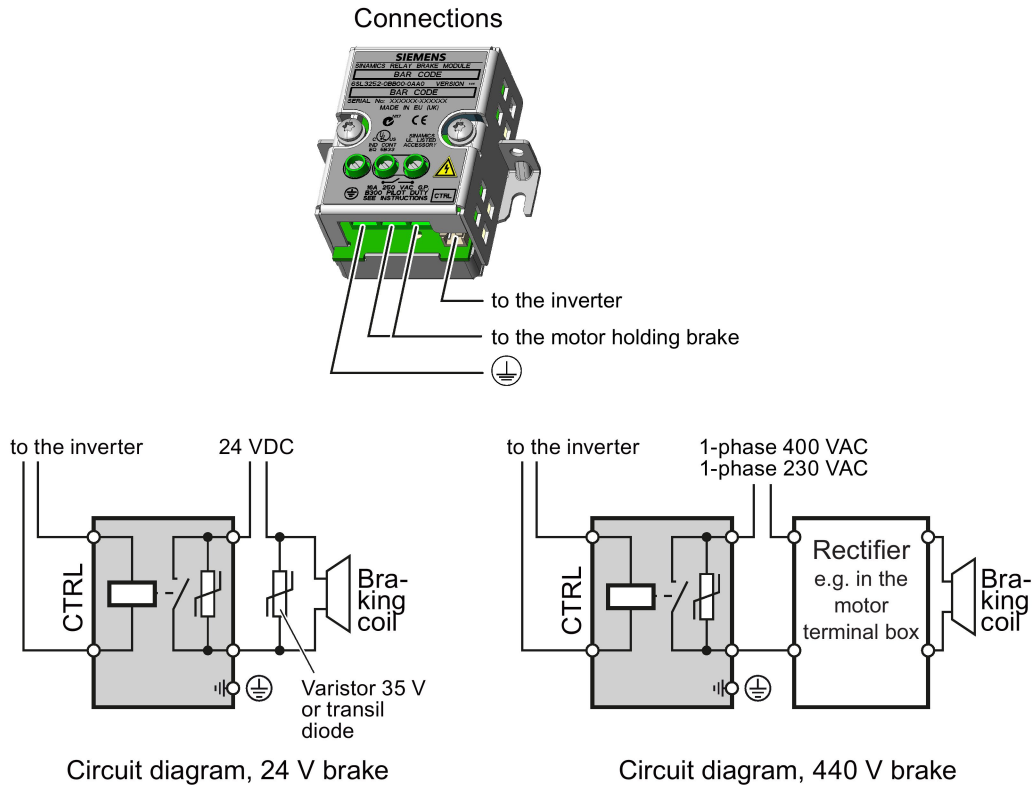
Connection to the inverter

To ensure that you have the correct cable for connecting the Brake Relay irrespective of the inverter size, you are supplied with two preassembled cables with different lengths. Connect the appropriate cable to the Brake Module and to the inverter as shown below.

If you are using your own cable, ensure that the cable is insulated and rated for 600 V.

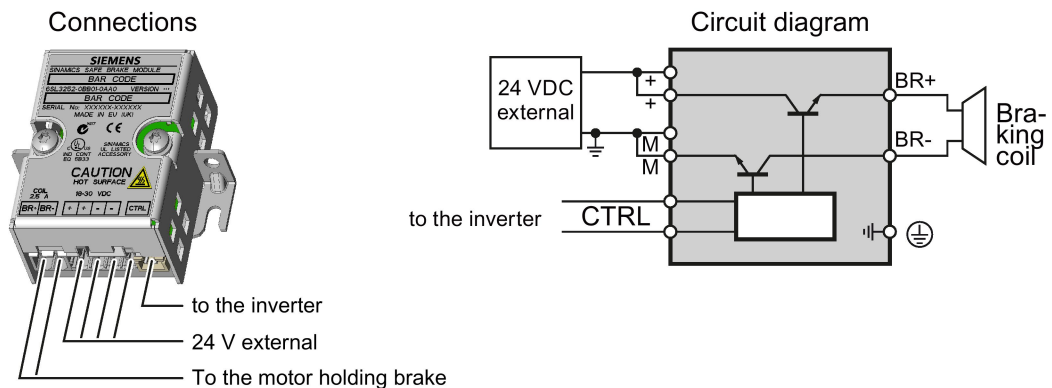
8.2.5.1 Mounting and connecting the brake relay

The Brake Relay must be connected to the protective conductor if the motor brake is supplied from a PELV circuit.



8.2.5.2 Mounting and connecting the brake relay

The Brake Relay must be connected to the protective conductor if the motor brake is supplied from a PELV circuit.



8.2.5.3 Technical data of the brake relay?

	Brake Relay 6SL32520BB000AA0	Safe Brake Relay 6SL32520BB010AA0
Input voltage	via the Power Module	20.4 ... 28.8 VDC ¹⁾
Input current	via the Power Module	Max. 2.5 A
Max. connection cross-section:	2.5 mm ²	2.5 mm ²
Degree of protection	IP20	IP20
Switching capability of the NO contact	1-phase 440 VAC, 3.5 A 1-phase 30 VDC, 12 A	-
Output voltage	-	24 V
Output current	-	max. 2 A

¹⁾ External, controlled power supply required. Recommended voltage: 26 VDC

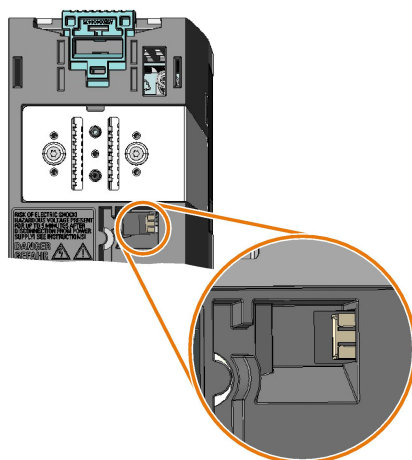
8.2.5.4 Mounting and connecting the brake relay

Installing the Brake Relay

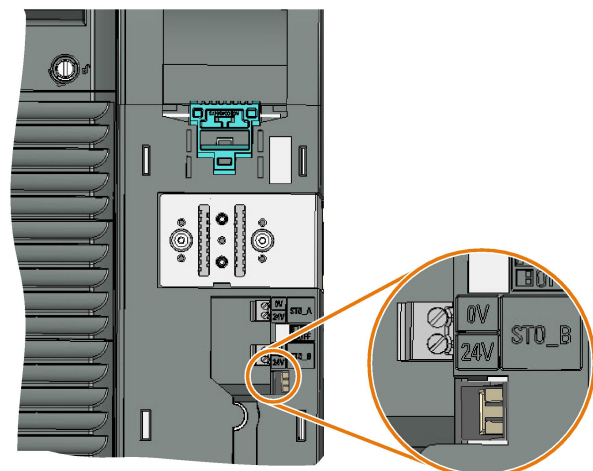
- **FSA ... FSC:** Install the Brake Relay next to the Power Module.
- **FSD ... FSF:** Install the Brake Relay at the rear of the lower shield plate. Attach the Brake Relay before you install the shield plate.

Connecting the Brake Relay to the inverter

The connector for the Brake Relay is located at the front of the Power Module. Lay the cable harness for the Brake Relay in the cable routing.



Brake relay connector for FSA ... FSC
Power Modules without STO terminals

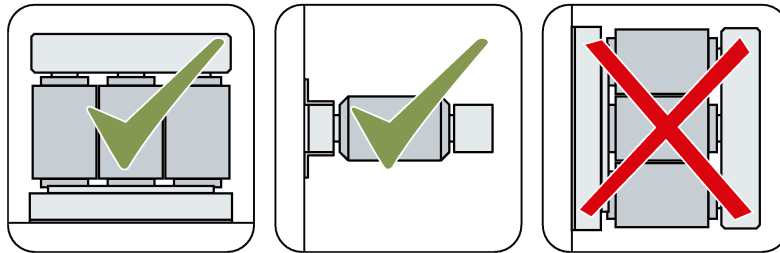


Brake relay connector for FSD ... FSF
Power Modules with STO terminals

8.2.6 Output reactor

8.2.6.1 Output reactor - clearances

Mounting position



Clearances to other devices

Keep shaded areas free of any devices and components.

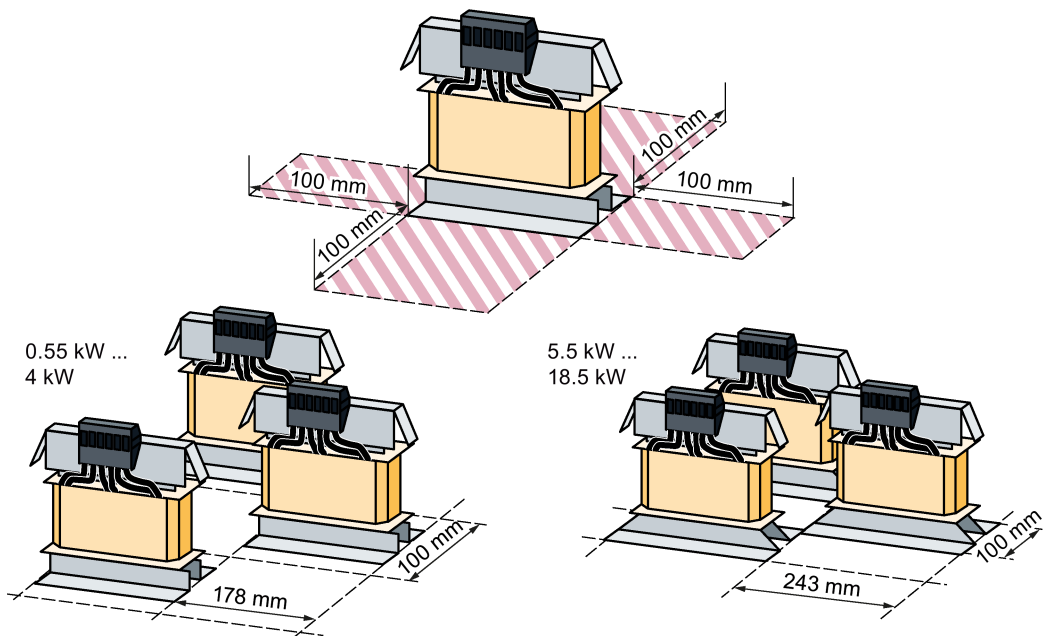


Figure 8-8 Minimum clearances of the output reactor to other devices, space-saving mounting examples

Dimensions and drilling patterns

0.55 kW ... 2.2 kW	
Dimensions [mm]	Drilling pattern [mm]
<p>M4</p> <p>175</p> <p>178</p> <p>207</p> <p>73</p>	<p>Ø 4.8 * 9</p> <p>166</p> <p>57</p> <p>Mounting: 4 * M4 bolts 4 * M4 nuts 4 * M4 washers Tightening torque: 3 Nm</p>

3.0 kW ... 4.0 kW	
Dimensions [mm]	Drilling pattern [mm]
<p>M4</p> <p>180</p> <p>178</p> <p>207</p> <p>73</p>	<p>Ø 4.8 * 9</p> <p>166</p> <p>57</p> <p>Mounting: 4 * M4 bolts 4 * M4 nuts 4 * M4 washers Tightening torque: 3 Nm</p>

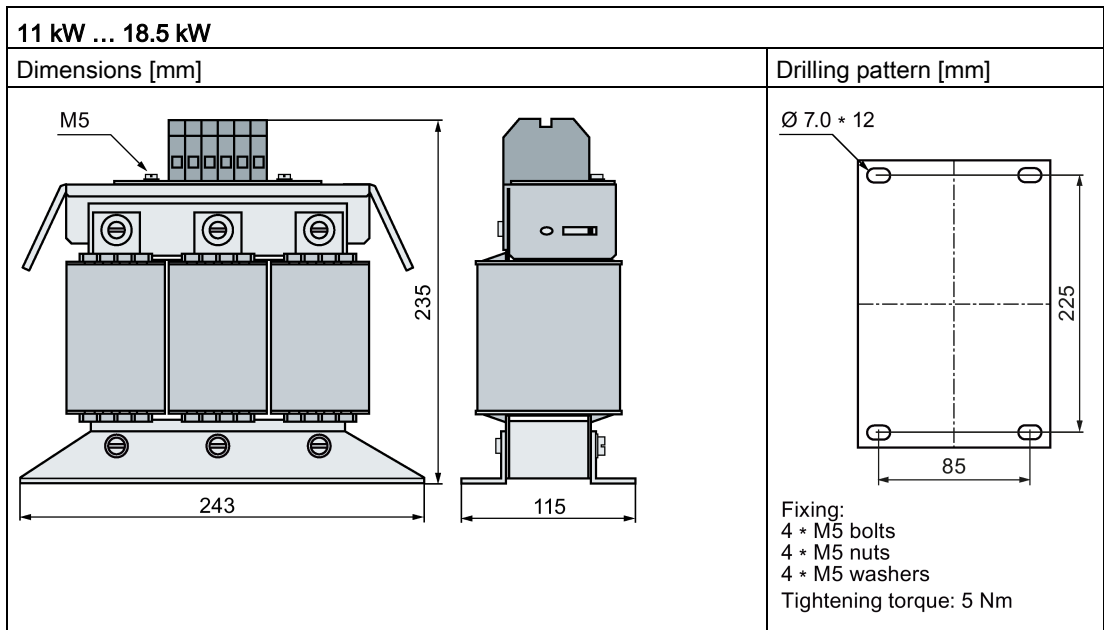
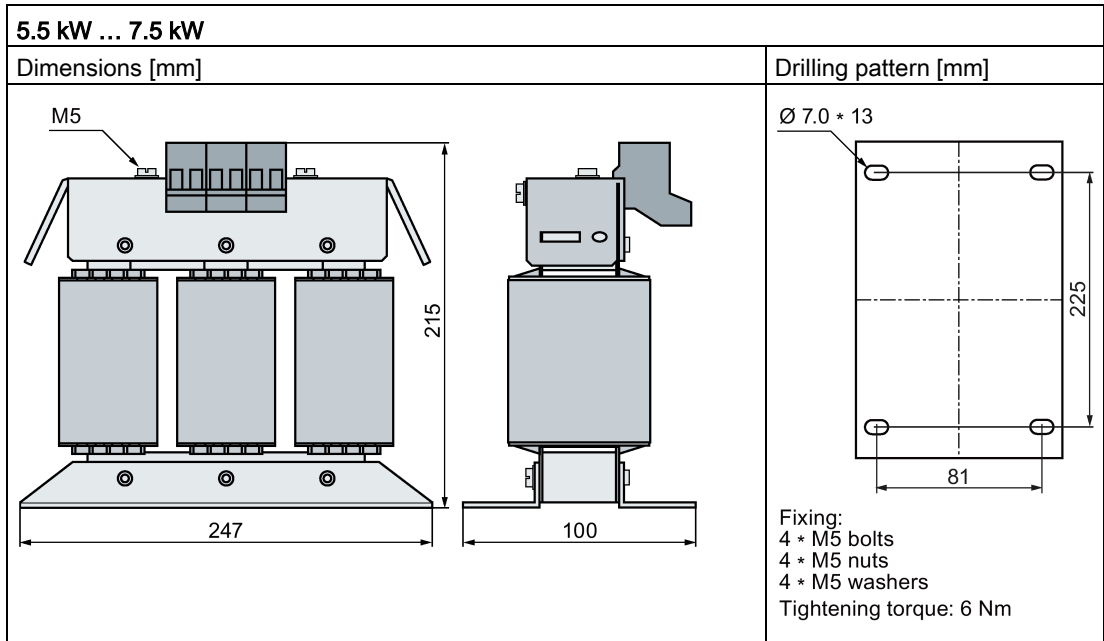


Table 8- 9 Technical data of the output reactors

Article number	6SL3202-0AE16-1CA0	6SL3202-0AE18-8CA0	6SL3202-0AE21-8CA0	6SL3202-0AE23-8CA0
Inductance	2.5 mH	1.3 mH	0.54 mH	0.26 mH
Degree of protection	IP20	IP20	IP20	IP20
Weight	3.4 kg	3.9 kg	10.1 kg	11.2 kg

Table 8- 10 Assignment table

Output reactor	400 V Power Modules	200 V Power Modules
6SL3202-0AE16-1CA0	6SL3210-1PE11-8□L1 6SL3210-1PE12-3□L1 6SL3210-1PE13-2□L1 6SL3210-1PE14-3□L1 6SL3210-1PE16-1□L1	6SL3210-1PB13-0□L0 6SL321□-1PB13-8□L0 6SL3210-1PB15-5□L0
6SL3202-0AE18-8CA0	6SL321□-1PE18-0UL1	6SL3210-1PB17-4□L0
6SL3202-0AE21-8CA0	6SL3210-1PE21-1□L0 6SL3210-1PE21-4□L0 6SL321□-1PE21-8□L0	6SL321□-1PB21-0□L0 6SL3210-1PB21-4□L0 6SL321□-1PB21-8□L0
6SL3202-0AE23-8CA0	6SL3210-1PE22-7□UL0 6SL321□-1PE23-3□L0	6SL321□-1PC22-2□L0 6SL3210-1PC22-8□L0

Appendix

A.1 Manuals and technical support

A.1.1 Manuals for your inverter



You can find manuals for download under (<https://support.industry.siemens.com/cs/ww/en/ps/13222/man>):

Table A- 1 Manuals for your inverter for download

Information depth	Manual	Manual number	Contents	Available languages
+++	Operating instructions for the following SINAMICS G120 Control Units:		Installing and commissioning the inverter, adapting fieldbus interfaces, description of the inverter functions, data backup and series commissioning, service and maintenance	
	CU230P-2	A5E34257946		
	CU240B-2 / CU240E-2	A5E34259001		
	CU240E / CU240S	A5E02440075		
	CU250S-2	A5E31759476		
+++	Function Manual Safety Integrated- For the SINAMICS G110M, G120, G120C, G120D inverters and SIMATIC ET 200pro FC-2 inverters	A5E34261271	Configuring PROFIsafe. Installing, commissioning and operating fail-safe functions of the inverter.	
+++	Hardware Installation Manual	A5E33294624	This manual	
+	Technical overview Safety Integrated for entry level personnel	80561520	Application examples for SINAMICS G drives with Safety Integrated	
++	The technical overview EMC - electromagnetic compatibility	103704610	Guidelines and standards, EMC-compliant control cabinet design	
+++	Configuration Manual EMC installation guideline	60612658	EMC-compliant control cabinet design, potential equalization and cable routing	

A.1.2 Configuring support

Catalog

Ordering data and technical information for SINAMICS G inverters.

Available languages:     



Catalog D31 for download or online catalog (Industry Mall):

All about SINAMICS G120 (www.siemens.com/sinamics-g120)

SIZER

The configuration tool for SINAMICS, MICROMASTER and DYNAVERT T drives, motor starters, as well as SINUMERIK, SIMOTION controllers and SIMATIC technology

Available languages:    



SIZER on DVD:

Article number: 6SL3070-0AA00-0AG0



SIZER for download:

Download SIZER (<http://support.automation.siemens.com/WW/view/en/10804987/130000>)

EMC (electromagnetic compatibility) technical overview

Standards and guidelines, EMC-compliant control cabinet design

Available languages:   



Technical overview for download:

EMC overview (<https://support.industry.siemens.com/cs/ww/en/view/103704610>)

EMC Guidelines configuration manual

EMC-compliant control cabinet design, potential equalization and cable routing

Available languages:      



Configuration manual for download:

EMC installation guideline (<http://support.automation.siemens.com/WW/view/en/60612658>)

Safety Integrated for novices technical overview

Application examples for SINAMICS G drives with Safety Integrated

Available languages:     



Technical overview for download:

Safety Integrated for novices
(<https://support.industry.siemens.com/cs/ww/en/view/80561520>)

A.1.3 Product Support



Additional information about the product and more is available in the Internet: Product support (<http://www.siemens.com/automation/service&support>).

This address provides the following:

- Actual product information (Update), FAQ (frequently asked questions), downloads.
- The Newsletter contains the latest information on the products you use.
- The Knowledge Manager (Intelligent Search) helps you find the documents you need.
- Users and specialists from around the world share their experience and knowledge in the Forum.
- You can find your local representative for Automation & Drives via our contact database under "Contact & Partner".
- Information about local service, repair, spare parts and much more can be found under "Services".

A.2 Disposal

Protecting the environment and preserving its resources are corporate goals of the highest priority for Siemens. Our worldwide environmental management system according to ISO 14001 ensures compliance with legislation and sets high standards in this regard. Environmentally friendly design, technical safety and health protection are always firm goals, even at the product development stage.

Recommendations for the environmentally friendly disposal of the machine and its components are given in the following chapter.

- Be sure to comply with local disposal regulations.
- Separate the housing parts according to their material.
- Dispose of the parts in accordance with the applicable legal regulations.
- Dispose of the packaging material in accordance with the applicable legal regulations.

Components

- Sort the components for recycling according to whether they are:
 - Electronic waste
 - Scrap iron, e.g. shield plates
 - Aluminum
 - Insulating materials and plastics

A.3 Standards

European Low Voltage Directive



The SINAMICS G120 product series meets the requirements of the Low-Voltage Directive 2006/95/EC. The devices are certified that they comply with the following standards:

- EN 61800-5-1 - Electrical power drive systems with adjustable speed

European Machinery Directive

Power Modules FSA ... FSC comply with the requirements of the Machinery Directive 2006/42/EC, if they are operated with a Control Unit that supports the safety functions.

Power Modules FSD ... FSF comply with the requirements of the Machinery Directive 2006/42/EC, independent of the Control Unit.

European EMC directive 2004/108/EG

When installed according to the recommendations described in this manual, the inverters fulfill all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN 61800-3.

ISO 9001

Siemens I DT MC operates a quality management system which complies with the requirements of ISO 9001.

Underwriters Laboratories



The device is listed by UL and CUL for power conversion in an environment with the pollution degree 2.

The inverters are UL approved (Underwriters Laboratories).

Frame sizes FSA ... FSC are tested according to standards UL508C and CSA22.2 No. 14.


Frame sizes FSD ... FSF are tested according to standards UL61800-5-1 and CSA 22.2 No. 274.

SEMI F47

Specification for semiconductor process equipment voltage drop immunity

SINAMICS G120 Power Modules PM240-2 meet the requirements of the standard SEMI F47-0706.

KC (Korea)

Inverters with the KC marking satisfy EMC requirements for South Korea.  EMC limit values in South Korea (Page 98).

RCM (Australia)

Inverters, frame sizes FSD ... FSF with integrated filter satisfy the EMC requirements for Australia.

Downloading certificates



You can find the certificates in the Internet under (<http://support.automation.siemens.com/WW/view/en/22339653/134200>).

A.4 Abbreviations

Abbreviation	State
AC	Alternating current
CE	Communauté Européenne
CU	Control Unit
DC	Direct current
DI	Digital input
DIP	DIP switch
DO	Digital output
ECD	Equivalent circuit diagram
EEC	European Economic Community
ELCB	Earth leakage circuit breaker
EMC	Electromagnetic compatibility (EMC)
EMI	Electromagnetic interference
FS...	Frame size ...
GSG	Getting Started Guide
HO	High overload
I/O	Input/Output
IGBT	Insulated gate bipolar transistor
LED	Light emitting diode
LO	Low overload
NC	NC contact
NEMA	National Electrical Manufacturers Association
NO	NO contact
OPI	Operating instructions
PELV	Protective extra low voltage
PM	Power Module
PPE	Personnel protective equipment
PT	Push-through technology
RCCB	Residual-current operated circuit breaker
RCD	Residual current device
RFI	Radio frequency interference
SELV	Safety extra-low voltage
VT	Variable torque

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Further information

SINAMICS inverters:
www.siemens.com/sinamics

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information about
the SINAMICS G120.



www.siemens.com/drives